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3.0 AFFECTED ENVIRONMENT

The existing environmental conditions at the Browns Ferry Nuclear Plant (BFN) site that would be affected by the proposed alternatives are described in this chapter. Since the current operating licenses for Units 1, 2, and 3 do not expire until 2013, 2014, and 2016, respectively, but work on recovering Unit 1 or constructing a dry cask storage facility for spent fuel could begin as early as 2002, the affected environment addresses projected changes between 2002 and 2016.

In accordance with Council on Environmental Quality regulations, the affected environment is "interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment," (40 CFR 1508.14). The descriptions of the affected environment provide bases for understanding the direct, indirect, and (where applicable) the cumulative effects of the alternatives. The affected environment text is subdivided by subject area and includes human interaction aspects as well as descriptions of the physical and biological topics. Existing environmental conditions are also representative of the conditions that are expected to exist under the No Action Alternative, which is to operate Units 2 and 3 only until the end of their existing licenses.

3.1 Air Resources

3.1.1 Climate and Meteorology

The local climate and meteorology of the BFN site is characterized in the TVA BFN Environmental Statement, Volume 2, Section 3.3, which was prepared in the early 1970s. More extensive information and detailed data summaries, especially for on-site meteorological data, can be found in Section 2.3 of the Final Safety Analysis Report (FSAR). Among minor climate variations that have been observed during the past century was a trend of decreasing average temperatures from the 1930s and 1940s to the 1970s that was followed by the current warming trend. This warming trend is expected to continue through the renewed license period. However, the conditions for the 1879-1958 period of temperature data presented in the original Environmental Statement are expected to be representative of these near future conditions that will extend well into the 2030s. Other climate and meteorology variables are also not expected to change significantly in that time frame.

3.1.2 Ambient Air Quality

National Ambient Air Quality Standards establish concentration limits in the outside air for six pollutants: particulate matter, sulfur dioxide, carbon monoxide, ozone, nitrogen dioxide, and lead. These standards are designed to protect public health and welfare. With one exception, the standards are essentially unchanged from those considered in the TVA Environmental Statement of the early 1970s. The standard for hydrocarbons in effect at that time was later rescinded and a standard for ozone was implemented. An area where any air quality standard is violated is designated as a nonattainment area for that pollutant, and emissions of that pollutant from new or expanding sources are carefully controlled. There are no nonattainment areas near the BFN site, which is located in Limestone County, Alabama. Although Huntsville, Alabama, in adjacent Madison County is currently in attainment of the one-hour ozone standard and the particulates standard, United States Environmental Protection Agency (EPA) promulgated new, more restrictive standards for ozone and particulate matter in July 1997. These new standards, including an eight-hour standard for ozone that would supersede the old one-hour standard, have been challenged in the courts and are unlikely to be implemented until after the year 2003, if they withstand legal challenge. Full implementation of the new standards is expected to take place over a period of several years. However, it is anticipated that Madison County and possibly some surrounding counties will face significant air quality compliance problems for ozone and particulate matter.

In addition, Prevention of Significant Deterioration (PSD) regulations that restrict emissions and any significant reduction in ambient air quality include protection of national parks and wilderness areas that are designated PSD Class I air quality areas. A new or expanding major air pollutant source is required to estimate potential impact of its emissions on the air quality of any nearby Class I area, as specified by the State or local air regulatory agency, with input from the Federal Land Manager(s) having jurisdiction over the given Class I area(s). The closest PSD Class I area is the Sipsey Wilderness Area about 28 miles (45 kilometers) southwest of BFN.

3.1.3 Existing Air Emission Sources

Sources of non-radiological air pollutants at BFN include the mechanical draft cooling towers, the auxiliary steam boilers for heating and other uses, the diesel-powered auxiliary (emergency) generators, and miscellaneous other small sources such as fuel storage facilities. The cooling towers, auxiliary boilers, and diesel generators and associated estimated emissions are discussed in the TVA Environmental Statement, Volume 1, Section 2.5.

In Volume 1, Section 2.5, of the original Environmental Impact Statement (EIS), potential emissions and ambient air quality impacts are discussed. However, these earlier analyses only considered emissions from four of the eight diesel generators at the site. The emission estimates from the eight diesel generators should have been twice the emission estimates used in the original EIS. However, this does not change the expected impacts on air resources analyzed in the original EIS because those impacts are still enveloped by the combination of the auxiliary boilers and the diesel generators that was assessed. The auxiliary boilers were evaluated for the maximum possible fuel consumption, and the expected actual maximum annual operation was stated to be less than half the level that was assessed.

Actual emissions are much smaller than those estimated in the original EIS, with one exception. There is an inconsistency in the estimated emissions and ambient concentration for carbon monoxide in Section 2.5 in comparison to the magnitudes for the other pollutants calculated there and the relative magnitudes for the actual annual emissions reported during 1996-1999. Apparently, the carbon monoxide emissions and ambient concentrations presented in Section 2.5 are about two orders of magnitude too small. However, the ambient air quality standard is still about five orders of magnitude larger than the revised estimate. Thus, the impact of carbon monoxide emissions is still considered negligible, consistent with the conclusion in Section 2.5, Volume 1, of the original EIS.

Though generation of carbon dioxide (CO_2) at a nuclear facility is very minor compared to that of a fossil-fueled plant, the auxiliary boilers, emergency diesel generators, diesel-driven pumps, motorized vehicles, etc., collectively produce approximately 4,250 tons of carbon dioxide per year at BFN.

Potential impact on ambient air quality from operation of the cooling towers is associated with particulates emitted as part of the drift losses. Conservative estimated emissions of particulates are presented in Section 2.5, Volume 1, of the original EIS. Associated assumptions included closed mode operation for 7% of the time, helper mode operation for 22% of the time, and a conservative drift loss rate of 0.1%. Actual operating experience under the thermal regulations in effect, the reservoir conditions, and the plant's cooling requirements has shown that closed mode operation of the cooling towers has been unnecessary and is not expected to be done in the future. Cooling tower operation is conducted only in the warmer months of the year. During the last six years, Units 2 and 3 have both been back in service and the greatest amount of time that cooling tower operation has been required has been about 8% of a year.

The Plant operates under the air quality permit category of a minor source of air pollutants as approved by the State of Alabama air regulatory agency, Alabama Department of Environmental Management (ADEM).

3.1.4 Air Quality During Refurbishment

Air quality conditions are expected to remain about the same as now during the refurbishment period, with the exception of possible regulatory constraints that may develop in association with the eventual implementation of the new EPA standards on ozone and particulates.

3.2 Geologic Setting

3.2.1 Local and Regional Geology

The local and regional geology are described in section 3.3 of the original EIS.

3.2.2 Geologic Structure and Faulting

The BFN area is underlain by flat-lying, underformed limestone of the Mississippian age. The site lies on the southeastern flank of the Nashville structural dome where it merges into the foreland slope of the Appalachian geosyncline. The Nashville dome controls the regional geologic structure, and the regional dip is a degree or less to the southeast. During its history, this immediate region has been one of little deformation. Major folds and faults are entirely absent. No active faults showing recent surface displacement are known within a 200-mile radius of the site. The nearest known ancient fault is in Lawrence County, Alabama, 16.5 miles to the west-southwest from the BFN site. This fault is one of three apparently related near-vertical faults that cut Mississippian bedrock and have vertical displacements that vary from 0 to 60 feet (BFN UFSAR).

3.2.3 Seismicity

Significant centers of seismic activity are considered to be regions that have produced large earthquakes (magnitude greater than 6.0) in historical time. For BFN the nearest examples of such seismic source zones include the New Madrid Seismic Zone in the central Mississippi Valley in the vicinity of New Madrid, Missouri and the Charleston Seismic Zone near Charleston, South Carolina. BFN is approximately 200 miles from the New Madrid Seismic Zone and approximately 400 miles from the Charleston Seismic Zone. Both of these seismic zones have produced one or more earthquakes that caused damageover a wide area.

The December 7, 2001, magnitude 3.8/3.9 earthquake that occurred west of Scottsboro, Alabama was not associated with a seismic source zone that has generated large earthquakes in historical time. The earthquake's epicenter was about 50 miles from BFN and 17 miles from TVA's unfinished Bellefonte Nuclear Plant site located approximately six miles northeast of Scottsboro. The event was not felt nor noticed in any way at Browns Ferry. BFN staff confirmed that the seismic instruments were operable and that the seismic alarm, set at 0.01 G., did not activate.

The earthquake was not "felt" at Bellefonte. However, TVA staff in the control room did hear a rumble that sounded like something heavy being dragged along the roof. It seemed to last approximately 5 to 6 seconds. No books fell from shelves, nor did any objects topple. Inspections of the site the evening of the earthquake and the following morning revealed no damage and nothing out of place. Bellefonte does not have a seismic instrument.

The December 7, 2001 earthquake occurred in the Southern Appalachian Seismic Zone as defined by Bollinger (1973). The largest earthquake known to have occurred within this zone occurred in Giles County, Virginia in 1897 with a magnitude of approximately 5.8.

Earthquakes of the size (3.8 magnitude) that occurred near Scottsboro, Alabama on December 7, 2001, could be expected to occur somewhere within the southern Appalachians about once every three years (Bollinger, et al, 1989). The southern Appalachian seismic zone extends from central Alabama to western Virginia, and therefore, most earthquakes occurring in this zone are much farther from BFN than the recent one near Scottsboro. Two aftershocks were associated with the Scottsboro earthquake (both quite small), and it appears the aftershock sequence ended in less than a month.

As shown by the U.S. Geological Survey's 1996 national seismic hazard maps, BFN is located in a region of low seismic hazard. Although infrequent, small earthquakes (magnitude less than 4.0) are likely to continue to occur in the area around BFN. However, earthquakes of this size, even if much closer to BFN than the December 7, 2001 earthquake, produce ground motions that are considerably smaller than those for which the plant is designed and thus pose no threat to plant safety.

3.3 Solid Wastes Management and Past Practices

Solid wastes generated in conjunction with operation of BFN can be subdivided into four general categories:

1. General plant trash consisting of paper, metals, garbage and other items;
2. Construction and demolition debris associated with site activities;
3. Low Level radioactive solid wastes which consists of spent resins, and dry active waste (DAW) (contaminated protective clothing, paper, rags, glassware, and trash); and
4. Hazardous Wastes as defined under the Resource Conservation and Recovery Act (RCRA).

All of these solid wastes are managed in accordance with applicable Nuclear Regulatory Commission (NRC), State, and Federal environmental regulations, and disposed in approved and licensed disposal facilities.

3.3.1 General Plant Trash

General plant trash collected as part of routine plant operation activities is managed through a TVA wide contract with a licensed waste disposal company. Waste material is collected in dumpsters and transported to a State licensed regional landfill permitted to accept Subtitle D waste materials from Limestone County. At the current time, Alabama has greater than ten years of remaining landfill capacity. Generation rates for this type of material are currently approximately 50 tons per month. BFN has an active recycling program that segregates and recycles scrap metal, cardboard, paper, batteries, and aluminum cans at approved State and local recycling facilities.

3.3.2 Construction/Demolition Debris

BFN operates a State permitted Construction/Demolition (C/D) landfill (Permit Number 42-02) within the confines of the BFN site. This landfill is permitted to accept non-hazardous, non-radioactive solid wastes including scrap lumber, bricks, sandblast grit, crushed metal drums, glass, wiring, non-asbestos insulation, roofing materials, building siding, scrap metal, concrete with reinforcing steel and similar construction and demolition wastes at an average daily volume of five tons per day from the BFN site. The landfill is approximately 7.7 acres in size. The generation rate for this type of material over the past two years is approximately 0.04 tons per day. The C/D landfill permit is issued for five-year permit cycles, with the current permit set to expire in May 2005.

3.3.3 Low-Level Radioactive Waste

Spent resins are packaged, de-watered and temporarily stored on-site in concrete storage modules until they are shipped for burial offsite in a licensed disposal facility. DAW is collected within the plant, and transported to a waste processor for volume reduction and subsequent shipment to a licensed disposal repository, such as the Envirocare of Utah, Inc. burial facility. Irradiated non-fuel plant components are stored on-site or processed for shipment to a licensed disposal facility. Generation rates for these types of materials are approximately 30-40 cubic meters per month.

3.4 Hazardous Wastes Management and Past Practices

As is the case with any large industrial facility, BFN generates a variety of wastes that are classified as hazardous under RCRA. These wastes include paint related materials, spent solvents used for cleaning and degreasing, as well as Universal Wastes such as spent batteries, fluorescent light tubes etc. TVA operates a Hazardous Waste Storage Facility (HWSF) in Muscle Shoals that holds a RCRA Part B permit for temporary storage of hazardous wastes. The HWSF serves as a central collection point for TVA-generated hazardous wastes, and maintains contracts with waste treatment and disposal facilities through TVA's Environmental Restricted Awards Process. All hazardous waste generated at BFN is shipped to the HWSF for consolidation, storage, and disposal through approved and licensed facilities. BFN recycles paint solvents (primarily Methyl Ethyl Ketone) using an on-site still. Universal wastes are collected for recycling and shipped to recycling firms listed on the ERAL. Hazardous waste generation rates for BFN average approximately 3,400 pounds per calendar year. While not a hazardous waste as defined in the RCRA regulations, Used Oil is also generated at BFN as a result of maintenance activities on plant equipment. All used oil is collected, stored on site, and shipped to an approved recycling center for energy recovery.

3.5 Spent Fuel Management

A 20-year extension of the BFN operating licenses including three-unit operation would impact spent fuel management in the quantity of spent fuel storage required. As described in section 2.3, a BFN Independent Spent Fuel Storage Installation (ISFSI) is proposed for operation beginning 2005. Expansion of an ISFSI can be accomplished incrementally, provided adequate space is allotted in the initial design. This technology can accommodate life-of-plant requirements regardless of Department of Energy (DOE) repository schedules or plant operation changes.

After implementation of spent fuel dry storage, sufficient capacity would be maintained in the spent fuel pool to accommodate refueling outages. Older spent fuel would be transferred to dual-purpose storage modules (i.e., metal cask or canister with overpack) for storage at the BFN ISFSI. The fuel transfer from pool storage racks to dry storage modules would be performed in the spent fuel pool. The dry storage system would be licensed for both on-site storage in accordance with 10 CFR 72 and off-site transportation in accordance with 10 CFR 71. Consequently, these dry storage systems do not require fuel to be repackaged for transport to a DOE repository.

Depending on the dry storage system design chosen for BFN, each storage module could contain up to 68 spent fuel assemblies. Assuming a storage module design with a 68-fuel assembly capacity, five modules would typically be loaded before each refueling outage. After loading, the dual-purpose storage module would be drained, dried, decontaminated, sealed, and then transferred by crane to the truck bay for transport to the ISFSI site. The storage module containing spent fuel would be temporarily stored at the ISFSI until a DOE spent fuel repository is available.

Appropriate dual-purpose system components used for fuel storage would also be used for fuel transportation to the DOE repository. Preparation for transport varies depending on design of the dry storage system chosen. Transport preparation typically includes testing of the storage module seal integrity, then addition of impact limiters for metal (non-canister) systems or addition of a transport overpack and impact limiters if modular systems are used. These operations can be completed either at the ISFSI site, provided an appropriate crane system is available, or at a specially constructed transfer facility. The only part of a dry storage module that would remain on site after shipment to DOE is the storage overpack (if a modular canister design is used).

3.6 Surface Water Resources

3.6.1 Wheeler Reservoir Description

BFN is located on Wheeler Reservoir at Tennessee River Mile (TRM) 294. The reservoir extends from Guntersville Dam at TRM 349 to Wheeler Dam at TRM 274.9. The drainage area upstream of Wheeler Dam is 29,590 square miles. The reservoir was created in 1936 as one of the first major dam projects on the Tennessee River for flood control, power generation, and navigation. Wheeler has a normal summer elevation of 556 feet (mean sea level) msl and a minimum water elevation of 550 feet. The lake usually reaches summer elevation by April 15. Fall drawdown, in anticipation of winter rains, usually begins around August 1. At summer pool elevation, the reservoir has an area of 67,070 acres, a volume of 1,050,000 acre-feet, a mean depth of 15.7 feet, and a hydraulic residence time of 10.6 days.

Rainfall in the area averages 57 inches per year, with March being the wettest month at 6.6 inches, and October the driest month at 3.3 inches. The average monthly air temperature ranges from 39°F in January to 79°F in July with an annual mean of about 60°F. Average unregulated streamflow at the dam is 49,800 cubic feet per second (cfs) or 1.7 cfs per square mile of drainage area. Historically, the dissolved oxygen concentration of reservoir releases ranges from about 11 milligrams per liter (mg/L) in late January to 6 mg/L in early July with an annual average of 8 mg/L. The release water temperature ranges from about 43°F in January to 84°F in July with an annual average of 68°F. Most of Wheeler Reservoir is classified by ADEM for public water supply, swimming and other whole body water-contact sports, and fish and wild life. The area of the reservoir immediately upstream and downstream of BFN is classified for swimming and other whole body water-contact sports and fish and wild life. Reservoir water quality is generally good and suitable for most designated uses. The one exception is a ten-mile reach of the river between Wheeler Dam and the Elk River which is on the state 303 (d) list as partially supporting its designated uses due to pH and temperature/thermal modifications caused by industrial sources and flow regulation and modification. Table 3.6-1 summarizes general water quality conditions in Wheeler Reservoir using 1990 through 1998 data available from EPA STORET.

Table 3.6-1 Summary of Wheeler Reservoir Water Quality[a]						
Parameter	Units	Number Samples	Mean	Standard Division	Maximum	Minimum
Turbidity	NTU	63	8.91	11.07	75.0	1.2
Secchi Depth	meters	305	1.06	0.39	2.5	0.2
Total Alkalinity	mg/L	462	58.13	8.74	112	15
Dissolved Oxygen	mg/L	6542	7.42	1.98	16.8	0.1
Temperature	°F	6537	78.66	8.39	91.9	43.6
BOD_5	mg/L	2334	2.39	1.36	11.0	0.1
Total Suspended Solids	mg/L	2669	6.38	5.05	130	1
Fecal Coliform	100ml	168	159.6	556.8	6200	0
Organic Nitrogen	mg/L	166	0.26	0.27	1.3	0.02
NH_3+NH_4 Nitrogen	mg/L	613	0.058	0.068	0.88	0.01
NO_2+NO_3 Nitrogen	mg/L	622	0.30	0.32	3.8	0.01
Total Phosphorus	mg/L	624	0.056	0.11	1.8	0.002
Total Organic Carbon	mg/L	144	2.35	1.06	5.9	0.2

[a]EPA STORET data collected by ADEM, EPA Region IV, and TVA from 1990 through 1998.

3.6.2 Water Quality

Using conventional classification methods, Wheeler Reservoir would be considered eutrophic (Higgins and Kim, 1981). TVA 1999 Vital Signs Monitoring rated the overall ecological condition of the reservoir as fair (TVA, 2000). The 1999 rating was lower than previous years, primarily due to less than normal rainfall. Much of the summer of 1999 was characterized by low flows that increased reservoir retention time, algal production, and dissolved oxygen depletion. Dissolved oxygen concentrations of less than 2.0 mg/L occurred during summer thermal stratification at two of the four sampling sites; at times comprising up to 25% of the water column and 75% of the bottom length. There were no swimming advisories on Wheeler Reservoir in 1999. Fecal coliform bacteria in samples collected at five swimming beaches and four boat ramps were within the State of Alabama guidelines for water contact.

3.6.3 Temperature

Water temperature patterns in Wheeler Reservoir are constantly changing in response to varying meteorological and flow conditions. Important heat transfer variables include air temperature, relative humidity, wind speed, solar radiation, evaporation, advection, and convection. Reservoir flow rates and geometry are also key factors. For a detailed discussion of hydrothermal conditions in Wheeler Reservoir see TVA, 1983.

BFN is located in a region of expanding reservoir cross section. Upstream riverine conditions change to deep channel and expansive overbank just upstream of BFN. Downstream, the reservoir is deep and wide. River flows depend on discharges from upstream Guntersville Dam and downstream Wheeler Dam. Travel times from BFN to Wheeler Dam range from three days to two weeks, depending on river flows.

The current temperature limits for the BFN thermal discharge, obtained via Section 316(a) of the Clean Water Act, include two parameters--the maximum temperature downstream of the plant, and the maximum temperature rise from upstream to downstream of the plant. These limits must be met at the edges of a mixing zone with the following dimensions: 1) a maximum length of 2,400 feet downstream of the diffusers; 2) a maximum width of 2,000 feet; and 3) a maximum length of 150 feet upstream of the diffusers to the top of the diffuser pipes and extends to the bottom downstream of the diffusers. Downstream river temperature measurements are obtained by three permanent monitoring stations located in a line across the reservoir at approximate river mile 293.45. Upstream river temperature measurements are obtained by a permanent monitoring station located in the main channel at about river mile 297.8. The maximum temperature downstream of the plant includes a 1-hour average limit and a 24-hour average limit. The one-hour average limit is 93°F (33.9°C) and the 24-hour average limit is 90°F (32.2°C). The maximum temperature rise includes only a 24-hour average limit, which is 10 Fahrenheit degrees (5.6 Celsius degrees). Historical data shows that it is possible for the 24-hour average upstream (i.e., ambient) water temperature to exceed 90°F. To allow plant operation under these conditions, if the upstream 24-hour temperature exceeds 90°F, the 24-hour downstream temperature may equal, but not exceed, the upstream value. That is, the temperature rise must be zero or less. As ambient temperature increases, this type of operation is acceptable until the 1-hour average limit of 93°F is obtained.

Natural water temperatures in the reservoir vary from around 35°F in January to near 90°F in July. Monthly changes of 15 to 20°F are common in the spring and fall. Meteorological conditions can cause temperatures throughout the reservoir to change 5°F in ten days. Daily variations due to solar heating can cause 1 to 2°F changes during fully mixed conditions and up to 3 to 5°F changes in the surface layer down to five feet.

Temperature patterns upstream of BFN are fully mixed during the fall, winter, and spring with weak thermal stratification from June through September. Temperatures in the overbank near BFN are similar to those in the main channel except that the overbank areas are more responsive to changing meteorological conditions. Spatial differences, overbank to main channel, caused by wind and flow mixing can cause 1 to 3°F differences on an hourly basis. In the lower portion of the reservoir weak thermal stratification can result in a 5°F difference from surface to bottom.

3.6.4 Water Intakes and Wastewater Discharges

Tables 3.6-2 and 3.6-3 list the potable water supply intakes and wastewater discharges on Wheeler Reservoir (ADEM, 2001). There are eight water intakes withdrawing approximately 124 million gallons per day (MGD) for municipal and industrial use. Wastewater discharges include ten municipal plants discharging over 30 MGD and 17 industrial plants discharging over 2,466 MGD.

3.6.5 Water Use Conflicts

Consumptive and off-stream water uses have not resulted in significant use conflicts due to the large volume of reservoir water available, the high river flow rate, and the return of most of the water withdrawn. Regulatory control of withdrawal rates and National Pollutant Discharge Elimination System (NPDES) permit limits for return water quality also mitigate potential conflicts. Potential trade-offs can occur with instream water uses, however (e.g., instream use conflicts among aquatic life, waste assimilation, navigation, power generation, flood control, and lake levels). These potential conflicts are addressed by historic operating procedures, legal requirements, and regulatory procedures.

Table 3.6-2 Potable Water Intakes on Wheeler Reservoir

Name	Intake Location	Population Served	Daily Use (MGD)
Municipal			
West Morgan - East Lawrence Counties	TRM 286.5	24,000	4.0
Decatur Utilities	TRM 306.0	64,500	27.2
Huntsville Utilities	TRM 319.4	199.500	16.5
Huntsville Utilities (South Plant)	TRM 334.2	199,500	8.5
Northeast Morgan County Water Authority	TRM 334.7	17,529	0.9
Industrial			
Redstone Arsenal - Plant 2	TRM 330.2	19,940	11.3
Redstone Arsenal - Plant 1	TRM 323.9	1,240	0.7
International Paper Co. (Courtland)	TRM 282.4	2,500	55.0

Table 3.6-3 Wastewater Discharges on Wheeler Reservoir		
Name	Location	Flow (MGD)
Municipal		
Decatur Dry Creek	Dry Branch Mile 0.6 at TRM 302.8	18.5
Huntsville West Area	TRM 318.5	11.1
Priceville WWTP	TRM 311.5	0.2
Cotaco School	Cotaco Creek Mile 2 at TRM 319.2	N/A
Crosscreek Subdivision	TRM 317	N/A
Lawson Trailer Park Lagoon	TRM 303.1	N/A
Reid School	TRM 298	N/A
Sherbrooke Utilities Inc.	Dry Creek Mile 1 at TRM 328.5	N/A
Tanner High School	TRM 301	N/A
Union Grove Junior High School	Shoal Creek Mile 2.1 at TRM 347	N/A
Industrial		
Saint Gobain Indust. Ceramics	TRM 335.1	1.2
Tru-Line Manufacturing	Flint Creek Mile 3 at TRM 308.4	N/A
General Electric Co.	TRM 307.1	0.3
Goodyear Tire & Rubber	TRM 305.9	N/A
Decatur Transit	TRM 302	N/A
Nova Chemicals	Dry Branch Mile 0.2 at TRM 302.8	N/A
3M Corporation	Bakers Creek Mile 0.1 at TRM 301.2	16.0
Air Products & Chemicals	Bakers Creek Mile 1 at TRM 301.2	N/A
BP Amoco Chemical	Bakers Creek Mile 0.1 at TRM 301.2	4.5
Cerestar USA – Decatur	Bakers Creek Mile 0.4 at TRM 301.2	1.3
Daikin America	Bakers Creek Mile 0.5 at TRM 301.2	1.5
Diamond Wood Treaters	Bakers Creek Mile 1 at TRM 301.2	N/A
Solutia Inc.	Bakers Creek Mile 0.9 at TRM 301.2	115.0
Solvay Advanced Polymers	Bakers Creek Mile 0.4 at TRM 301.2	N/A
City of Decatur/Morgan Co.	Trinity Branch Mile 2.4 at TRM 295.9	N/A
Trico Steel Co.	Trinity Branch Mile 2.4 at TRM 295.9	1.0
TVA BFN	TRM 294.4	2325.0*

* The discharge from BFN is cooling water, not Municipal or Industrial wastewater.

3.7 Groundwater Resources

3.7.1 Groundwater Occurrence

Shallow groundwater at BFN occurs within unconsolidated terrace deposits and residual soils, and along a relatively thin but highly weathered horizon (epikarst zone) at the top of bedrock. At depth, groundwater occurs exclusively in fractures and solution features of the Tuscumbia limestone and Fort Payne chert. The Tuscumbia limestone and Fort Payne chert are collectively described as the Tuscumbia-Fort Payne aquifer system. This aquifer system is the most important water-bearing unit in the site vicinity from a regional perspective since it is a source of water for both wells and springs in the area.

Recharge to the shallow groundwater system at the plant site is derived primarily from precipitation. Regional water balance studies (Zurawski, 1978) show that approximately 10 to 13 inches of this precipitation enters groundwater storage. A total of 18 monitoring wells have been installed at the BFN site since 1980 and groundwater level measurements were initially monitored on a monthly basis.

Groundwater levels at the site are generally highest during the months of January through March. During September and October, water levels are usually at a minimum. Correlation between water levels in site wells and neighboring surface waters indicates that the Tennessee River and plant water channels exert some control on local groundwater elevations and hydraulic gradients. The direction of groundwater movement is generally W-SW toward the Tennessee River. Exceptions to this directional flux occur at the plant site during dewatering operations that can reverse gradient conditions, in the vicinity of leaking water lines serving the site, in areas of topographic highs/lows, and in the vicinity of the Low-Level Radioactive Waste (LLRW) storage facility where more complex movement exists.

Within overburden soils at the site, groundwater movement is predominantly downward. Local areas of lateral flow likely occur near some streams, topographic lows, and where extensive root systems exist. Based on 15 undisturbed soil samples, Boggs (1982) determined that the saturated hydraulic conductivity of site soils in the vicinity of the LLRW storage facility averages 3.7E-08 feet per second. Water supply wells developed within such low permeability soils are primarily of limited capacity. Based on aquifer testing in a similar setting (Julian, et al., 1993) the cherty gravel horizon near bedrock (epikarst) can be significantly transmissive. Measured transmissivity values by Julian, et al. (1993) suggest horizontal hydraulic conductivity values that are from one to two orders of magnitude greater than those measured in the shallow Tuscumbia limestone. Observations of groundwater levels during early site borings (TVA, 1972) also suggest that groundwater within the epikarst zone and Tuscumbia-Fort Payne aquifer might be confined.

Groundwater flow in the Tuscumbia limestone occurs solely in fractured and weathered zones. The orientation of fractures and solution features within the Tuscumbia is coincident with a structurally controlled joint system (i.e., along strike and dip). Studies by Julian, et al. (1993) indicate that the transmissivities of bedrock fractures and solution features in the Tuscumbia may decrease with depth. However, the interconnectivity of these features is equally important. Although fractured, the silty, siliceous nature of the Fort Payne chert inhibits the development of solution features. Therefore, the average permeability of the Fort Payne at the site is expected to be less than that of the Tuscumbia limestone.

There are two sets of on-site lagoons at BFN.

Wastewater Lagoons. There is a series of three interconnected lagoons located north of the switchyard that are used to provide secondary treatment for the plant's sanitary wastewater. The lagoons were constructed using compacted clay and possess no synthetic linings. There is no monitoring of lagoon influent. However, effluent is discharged under the plant NPDES permit (DSN 013a(1)) that is monitored for flow, pH, BOD5, TSS, and fecal coliform. There are no groundwater monitoring wells installed in the vicinity of these lagoons.

Sedimentation Ponds. There are two sedimentation ponds (Ponds A & B) located east of the plant and adjacent to the end of the central perimeter (switchyard) drainage ditch. These ponds are both lined with Hypalon Synthetic liners. The ponds receive reject water from the Ecolochem Reverse Osmosis process used to generate demineralized water for the plant, water discharged from the Diesel Generator building sumps, and water from the Water Intake Building sump. Discharge from Pond A, the larger of the two ponds, is permitted under an NPDES permit (DSN 013b). The pond is released on a batch basis as needed, and the outfall is monitored for flow, pH, TSS and Oil and Grease under the terms of the NPDES permit. Pond B has no outfall. When it fills, effluent from Pond B is manually pumped to Pond A and released through the permitted outfall. Piping and valves are provided to allow flexibility in filling either of the ponds. There are no groundwater monitoring wells installed in the vicinity of these ponds. Although an original plant bedrock monitoring well (well 7) was located about 100 feet southwest of pond A (between the pond and the river), it was destroyed when the Ecolochem building was constructed.

3.7.2 Groundwater Use

The Tuscumbia-Fort Payne aquifer system provides volumes of water sufficient for domestic supplies and some municipal and industrial supplies in the region. Groundwater in this aquifer system is a calcium bicarbonate type and can generally be used without extensive treatment. Public groundwater supplies within a 50-mile radius of BFN were previously identified by TVA (TVA, 1972). An off-site well survey was conducted in May 1995 to identify groundwater supplies within a two-mile radius of the BFN site and this information is provided by TVA (1999). The closest known public groundwater supply (Limestone County Water System, Well G-1) resides approximately two-miles north of BFN (ADEM, 2001). There is no groundwater use by BFN, and site dewatering wells have been inactive since the 1980s.

3.8 Floodplains and Flood Risk

The BFN plant site is located on the right bank of Wheeler Reservoir at Tennessee River mile (TRM) 294.0 in Limestone County, Alabama. The affected project area could possibly be flooded from the Tennessee River, a small stream to the northwest of the plant site and the site drainage system. The site drainage system is broken into three areas: 1) the switchyard, 2) the main plant area, and 3) the cooling tower system. The area impacted by the construction of any of the alternatives extends from about Tennessee River mile 293.0 to mile 294.0.

3.8.1 Current Conditions

The 100-year floodplain for the Tennessee River would be the area below elevation 557.3. The TVA Flood Risk Profile (FRP) elevation on the Tennessee River would also be elevation 557.3. The FRP is used to control residential and commercial development on TVA lands. At this location, the FRP elevation is equal to the 500-year flood elevation. Results of studies completed in 1981 give an estimated Probable Maximum Flood (PMF) level of 570 at the BFN site, or 2.5 feet lower than that provided in Appendix 2.4A of the FSAR. However, the PMF design value of 572.5 feet will continue to be used with the 2.5 feet difference as a design margin. Consequent wave run-up above the flood level would be 1.7 feet on a vertical wall and 2.7 feet on a 3:1 grassed slope. A maximum flood elevation of 574 at the plant site results from a combination of the PMF and wind wave run-up on a vertical wall or 575 as a result of the PMF and wind wave run-up on a 3:1 grassed slope.

For the small stream to the northwest of the site and the internal site drainage system, the 100- and 500-year flood elevations have not been determined. No PMF elevations have been computed for the small stream northwest of the plant; however, the maximum possible discharge is 17,200 cfs. For the switchyard drainage channel, the PMF elevation at the holding pond at the downstream end of the channel would be 574.8 and the PMF elevation at the north corner of the switchyard would be 577.8. The PMF elevation between the office and service buildings would be 566.6. In the vicinity of the radioactive waste, reactor, and diesel generator buildings, PMF elevations for all modes of plant operation would not exceed elevation 564.0. In the cooling tower system of channels there is sufficient capacity to pass the PMF and condenser water (Reference: FSAR).

3.8.2 Anticipated Future Conditions

Flooding conditions during the term of the renewed license (up to year 2036) are expected to remain similar to current conditions. For the Tennessee River, all dams in the TVA system are assumed to be maintained and remain operational for the entire licensing period. Existing procedures used for determining the 100- and 500-year flood levels on the Tennessee River are currently being reviewed; however, no major changes are expected to the adopted flood elevations as listed above. In addition, urbanization within the 27,130 square mile drainage area upstream of BFN would not be expected to significantly increase the 100- and 500-year floods. The computation of PMF levels is based on adopted standards and procedures, and no changes to these procedures are expected within the licensing period. If there were a change in these procedures, or if a major flood event occurred during the licensing period, a reevaluation could be necessary.

In regard to the small stream to the northwest of the plant site and the site drainage system, total development of a small drainage basin will increase the 100- and 500-year flood discharges from a small amount up to 2.5 times the natural discharge from the basin, depending on the amount of impervious area associated with the development. For the small stream northwest of the plant site, significant development within the 1.35 square mile drainage area is not expected to occur during the next 35 years. If total development were to occur, the 100- and 500-year flood discharges could increase as much as 2.5 times the natural discharge, as stated above. The switchyard drainage channel area, the main plant area, and the cooling tower system area all have some existing impervious area within their drainage basins. Additional impervious area would increase the 100- and 500-year flood discharges by some amount, but should not cause flooding greater than that produced by the PMF event.

3.9 Terrestrial Ecology

3.9.1 Vegetation

BFN is located within the Highland Rim section of the Interior Low Plateau Physiographic Province as described by Fenneman (1938). Botanically, the project site occurs within the Mississippian Plateau section of the Western Mesophytic Forest Region as recognized by Braun (1950). In this region of northern Alabama, native forest communities generally consist of mixed oak forests varying composition in relation to topography and soils. Historically, upland forests in the project area were characterized by mixtures of southern red oak, black oak, post oak and white oak with dogwood commonly present in the understory. The clearing of forested lands for agriculture has converted many of these forest communities to early successional habitats, allowing representative native plant communities to become replaced by introduced plant species.

The area in and around the BFN has been heavily impacted and altered as a result of the construction and operation of the existing facilities. Field inspections of the areas associated with the proposed action reveal that little native vegetation remains. The proposed location for the new cooling towers consists of old field vegetation with scattered tree species including black locust, various oaks, loblolly pine, and eastern red cedar. *Sericea lespedeza* and broomsedge are among the dominant herbs. The proposed locations for soil deposition (required for the construction of the new cooling towers) consist of two hayfields and a fallow cotton field now vegetated by a dense thicket of blackberry, Japanese honeysuckle and *Sericea lespedeza*, with scattered saplings of black locust and eastern red cedar. No uncommon communities or otherwise sensitive vegetation occurs on or immediately adjacent to the project areas.

3.9.2 Wildlife

The Tennessee River and surrounding terrestrial habitats offer suitable habitat to a wide variety of wildlife species. The river is used extensively by a variety of waterfowl and wading bird species. Wheeler Wildlife Refuge, located upstream from BFN is one of the southern-most wintering areas for ducks and geese in the southeast. In suitable terrestrial habitats, wildlife such as white-tailed deer, coyote, eastern cotton-tailed rabbit and opossum are fairly abundant in the vicinity. Most habitats in the vicinity are used by a many species of mammals, birds, amphibians and reptiles. Numerous caves are reported from Limestone County. These sensitive habitats provide habitat for numerous cave-dwelling species of animals, mostly bats, amphibians and numerous species of invertebrates.

Extensive agricultural practices prior to the construction of the BFN and construction of the existing facility have led to a decrease in the overall diversity of habitats within the project area. Limited available wildlife habitat existing at the nuclear plant site includes early successional, old field habitats, with scattered trees and agricultural fields. Wildlife species most commonly observed in the project area include those species that are less sensitive to human disturbance and are common in the region. Common bird species include song sparrow, eastern meadowlark, eastern bluebird, northern mockingbird, and American robin. Amphibians such as spring peeper and upland chorus frogs are common in the area. Small mammals such as hispid cotton rat, least shrew, and meadow voles may be found in these habitats.

3.9.3 Introduced Species

As described in section 3.9.1, the lands of the BFN site have been heavily impacted and altered as a result of the construction and operation of the existing facilities. As a result of these disturbances, native plant communities have been converted to early successional habitats characterized by introduced (non-native) plant species such as *Sericea lespedeza*, Japanese honeysuckle and multiflora rose. Introduced plant species have the potential to impact terrestrial ecology resources through reductions in native biological diversity because of their potential for rapid establishment and spread in disturbed habitats, and their tendency to displace native vegetation (Tennessee Exotic Plant Council, 1996).

The densities of introduced plant species and the habitats in which they occur on the project lands are characteristic of such disturbed sites in the region. Various native (i.e., indigenous) plants occur in the area; however, no intact native plant communities exist on the lands to be disturbed by the proposed action.

Due to the lack of complexity of habitats and the presence of the facility, several non-native species of wildlife exists on the project lands. Species such as European house sparrow and European starling are common on the site.

3.9.4 Managed Areas and Ecologically Significant Sites

A review of the TVA Regional Natural Heritage database indicates that there are no Managed Areas or Ecologically Significant Sites on or adjacent to the proposed project site. However, two Managed Areas are known to occur within three miles of the BFN. These areas have been recognized and are protected, to varying degrees, because they contain unique natural resources, scenic values, or public use opportunities. The following paragraphs offer brief descriptions of each area including primary use and available facilities.

SWAN CREEK STATE WILDLIFE MANAGEMENT AREA

This wildlife management area includes over 3,000 acres of land and over 5,000 acres of water surrounded by numerous industrial facilities. Wooded lands and grassy pastures, occasionally interrupted by railroad tracks and transmission lines, provide one of the most important waterfowl management areas in the state of Alabama. Although the primary management focus is for waterfowl and small game hunting, this area is becoming increasingly important for migrating bird species. In addition, the area is increasingly utilized by bird watchers and other outdoor enthusiasts. These lands are owned by TVA and presently managed by the Alabama Department of Conservation (ADC).

MALLARD-FOX CREEK STATE WILDLIFE MANAGEMENT AREA

Encompassing approximately 700 acres of land and 1,700 acres of water, this wildlife management area is primarily utilized for small game hunting. Although the majority of these acres are owned by TVA, the ADC manages these lands for public use.

3.10 Aquatic Ecology

3.10.1 Fish

TVA has conducted extensive sampling of the fish community in the vicinity of BFN and elsewhere in Wheeler Reservoir in recent years, both in monitoring programs conducted specifically for BFN (Baxter and Buchanan, 1998), and as part of TVA's Reservoir Monitoring Program (Dycus and Baker, 2000). A total of 60 species (excluding hybrids) has been collected in recent years by various sampling methods (Table 3.10-1).

Cove rotenone samples were collected annually from 1969 through 1997 as a component of the TVA environmental monitoring program for BFN, to provide a database on the fish community in the vicinity of BFN, and later to serve as a part of the thermal variance monitoring program. In more recent samples, 52 species were collected in 1995; 45 species in 1996; and 43 species in 1997. Annual standing stock estimates were 105,655 fish/hectare (ha) and 683 kilograms per hectare (kg/ha) in 1995 and decreased to 11,713 fish/ha and 366 kg/ha in 1996, then increased to 24,497 fish/ha and 489 kg/ha in 1997. As usual, forage fish were numerically dominant in samples, and also dominated biomass estimates in 1995 and 1996, but rough fish were highest in biomass in 1997. Gizzard shad exhibited the highest biomass during all three years, followed by threadfin shad in 1995 and smallmouth buffalo in 1996 and 1997 (Baxter and Buchanan, 1998).

TVA began a program to systematically monitor the ecological conditions of its reservoirs in 1990. Previously, reservoir studies had been confined to assessments to meet specific needs as they arose. Reservoir (and stream) monitoring programs were combined with TVA's fish tissue and bacteriological studies to form an integrated Vital Signs Monitoring program. Vital signs monitoring activities focus on:

1. Physical/chemical characteristics of waters;
2. Physical/chemical characteristics of sediments;
3. Benthic macroinvertebrate community sampling; and
4. Fish assemblage sampling.

Fish are included in aquatic monitoring programs because they are important to the aquatic food chain and because they have a long life-cycle, which allows them to reflect conditions over time. Fish are also important to the public for aesthetic, recreational, and commercial reasons (Dycus and Baker, 2000).

Fish samples were taken in three areas of Wheeler Reservoir from 1990 through 1995, and again in 1997 and 1999 as part of TVA's Reservoir Vital Signs monitoring program. Areas sampled included the forebay (area of the reservoir nearest the dam), a mid-reservoir transition station in the vicinity of TRM 295.9, an upper-reservoir inflow station at TRM 348, and the Elk River Embayment. Although any fish species known from elsewhere in the reservoir could occur in the vicinity of BFN, results of sampling at the transition station are presented here because they are more representative of fish communities in the vicinity of BFN.

Reservoir Fish Assemblage Index (RFAI) ratings are based primarily on fish community structure and function. Also considered in the rating are the percentage of the sample represented by omnivores and insectivores, overall number of fish collected, and the occurrence of fish with anomalies such as diseases, lesions, parasites, deformities, etc. Compared to other run-of-the-river reservoirs, the fish assemblage at the Guntersville mid-reservoir station (TRM 295.9) rated poor in 1992 and 1999, fair in 1990, 1991, 1995, and 1997, and good in 1993 and 1994. In the fall of 2000, additional (i.e., not on the regular RFAI monitoring schedule) electrofishing and gill net samples were taken at the transition station (TRM 295.9) and a newly-established sampling station for future BFN monitoring at TRM 292.5. A total of 30 fish species (excluding hybrids) was collected; the fish assemblage rated good at TRM 292.5 and fair at TRM 295.9 (Table 3.10-1) (Dycus and Baker, 2001).

Table 3.10-1 Fish Species Collected in the Vicinity of BFN by TVA During BFN Monitoring and Reservoir Monitoring Activities, 1995-2000

Common Name	Fall 2000 Gill Net and Electrofishing TRM 292.5	Fall 2000 Gill Net and Electrofishing TRM 295.9	Cove Rotenone 1995-1997	Fall 1999 Gill Net and Electrofishing TRM 295.9
Chestnut lamprey	-	-	x	-
Spotted gar	-	x	x	-
Longnose gar	-	-	x	-
Bowfin	-	-	x	-
Skipjack herring	x	x	x	x
Gizzard shad	x	x	x	x
Threadfin shad	x	x	x	x
Central stoneroller	-	-	x	-
Grass carp	-	x	-	-
Spotfin shiner	-	-	x	-
Steelcolor shiner	-	-	x	-
Common carp	-	x	x	x
Striped shiner	-	-	x	-
Silver chub	-	-	x	-
Golden shiner	-	-	x	-
Emerald shiner	x	x	x	-
Ghost shiner	-	-	x	-
Mimic shiner	-	-	x	-
Bullhead minnow	-	-	x	-
Northern hog sucker	x	x	x	-
Smallmouth buffalo	x	x	x	x
Bigmouth buffalo	-	-	x	-
Spotted sucker	x	x	x	x
Silver redhorse	-	-	x	-
River redhorse	x	x	-	-
Black redhorse	x	-	-	-
Golden redhorse	-	-	x	x

Table 3.10-1 Fish Species Collected in the Vicinity of BFN by TVA During BFN Monitoring and Reservoir Monitoring Activities, 1995-2000

Common Name	Fall 2000 Gill Net and Electrofishing TRM 292.5	Fall 2000 Gill Net and Electrofishing TRM 295.9	Cove Rotenone 1995-1997	Fall 1999 Gill Net and Electrofishing TRM 295.9
Shorthead redhorse	-	-	x	-
Black bullhead	-	-	x	-
Yellow bullhead	-	-	x	-
Brown bullhead	-	-	x	-
Blue catfish	x	x	x	x
Channel catfish	x	x	x	x
Flathead catfish	x	x	x	x
Blackstripe topminnow	-	-	x	-
Blackspotted topminnow	-	-	x	-
Western mosquitofish	-	-	x	-
Brook silverside	x	-	x	-
Inland silverside	-	-	x	-
White bass	x	x	x	x
Yellow bass	x	x	x	x
Hybrid striped x white bass	-	x	-	x
Striped bass	x	-	-	x
Redbreast sunfish	-	-	x	-
Green sunfish	-	-	x	-
Warmouth	-	x	x	-
Orangespotted sunfish	-	-	x	-
Bluegill	x	x	x	x
Longear sunfish	x	-	x	-
Redear sunfish	x	x	x	x
Hybrid sunfish	-	-	x	-
Smallmouth bass	x	x	x	-
Spotted bass	x	x	x	x
Largemouth bass	x	x	x	x
White crappie	-	-	x	-
Black crappie	-	-	x	-
Stripetail darter	-	-	x	-
Yellow perch	-	x	x	x
Logperch	x	x	x	-
River darter	-	-	x	-
Sauger	x	x	x	x
Freshwater drum	x	x	x	x

3.10.2 Benthic Organisms

As mentioned, BFN is located on Wheeler Reservoir, which TVA classifies as a Run-of-river reservoir. Run-of-river reservoirs typically have short water retention times (one to two weeks) and little winter drawdown. Benthic habitats in the reservoir range from deposits of finely divided silts to river channel cobble and bedrock. The most extensive benthic habitat is composed of fine-grained brown silt, which is deposited both in the old river channel and on the former overbank areas. The overbank areas, on either side of the old river channel, are far more extensive than the channel and are the most productive (TVA, 1972). These overbanks, located directly across from BFN, extend approximately two miles downstream. The overbanks support communities of Asiatic and fingernail clams, burrowing mayflies, aquatic worms, and midges. Cobble and bedrock areas, found primarily in the old channel, support Asiatic clams, bryozoa, sponges, caddisflies, snails, and some leeches. The Asiatic clam is nonindigenous to North America and is common in the Tennessee River system.

TVA began a program entitled Vital Signs monitoring to systematically monitor the ecological condition of its reservoirs in 1990. Benthic macroinvertebrates are included in Vital Signs monitoring because of their importance to the aquatic food chain, and because they have limited capability of movement, thereby preventing them from avoiding undesirable conditions. Since 1995, Vital Signs samples have been collected in the late fall/winter (November - December). Depending on reservoir size, as many as three stations are sampled (i.e., inflow, transition, and forebay).

Benthic macroinvertebrate Vital Signs monitoring data are analyzed using metrics. The number of metrics has varied through the sample years as reservoir benthic analysis has been fine-tuned. The most recent analysis is comprised of nine metrics: taxa richness, EPT taxa, long-lived taxa, non-chironomid and oligochaete density, percent oligochaete, dominance, zero samples, non-chironomid and oligochaete taxa, and chironomid density. The number derived for each metric is totaled and the score is applied to a range of values that identify the overall condition of the benthic community (i.e., very poor, poor, fair, good, or excellent).

BFN is located a short distance downstream from the Vital Signs transition station on Wheeler Reservoir (TRM 295.5). The transition station is the zone considered to be between riverine (the inflow station) and impoundment habitats (the forebay station). Benthic community scores at the transition station ranged from “excellent” in 1994 to “good” in 1995 and “excellent” again in 1997 and 1999 (Dycus and Baker, 2000).

In addition to Vital Signs benthic macroinvertebrate monitoring, benthic community sampling in support of BFN thermal variance monitoring was begun in the fall of 2000 (and will continue at least for the term of the current permit cycle - five years). Station locations are TRM 296 and TRM 292, upstream and downstream of the BFN diffusers respectively. An analysis of the 2000 sample year data indicated the benthic community above BFN diffusers was in “excellent” condition and the community below the diffusers was in “good” condition (Dycus and Baker, 2001).

Freshwater mussel fauna are not assessed as part of TVA’s Vital Signs program; however, they are excellent indicators of water quality due to their sessile nature and inability to avoid perturbations impacting water quality. Mussels feed on microorganisms (protozoans, bacteria, diatoms) and organic particles suspended in the water that are brought into the body via siphon action and consumed.

Thirty-eight freshwater mussel species had been documented in Wheeler Reservoir through 1991 (Ahlstedt and McDonough, 1992). Twelve species were identified in the vicinity of BFN during a 1982 survey for a proposed barge facility (Henson and Pryor, 1982). Most recently, Alabama Fish and Game identified 14 species upstream of BFN and 12 species downstream (Jeffrey T. Garner, Alabama Game and Fish Division Malacologist, personal communication, 2001). A listing of these species appears in Table 3.10-2.

Table 3.10-2 Mussel Species Collected by Alabama Game and Fish Division Near Browns Ferry Nuclear Plant in 1999

Common Name	Scientific Name
TRM 292, October 13-14, 1999	
Washboard	*Megalonaias nervosa*
Pink heelsplitter	*Potamilus alatus*
Threehorn wartyback	*Obliquaria reflexa*
Mapleleaf	*Quadrula*
Threeridge	*Amblema plicata*
Pimpleback	*Quadrula pustulosa*
Elephantear	*Elliptio crassidens*
Flat floater	*Anodonta suborbiculata*
Ebonyshell	*Fusconaia ebena*
Fragile papershell	*Leptodea fragilis*
Giant floater	*Pyganondon grandis*
Pistolgrip*	*Tritogonia verrucosa*
TRM 298, August 17 and October 20, 1999	
Washboard	*Megalonaias nervosa*
Pink heelsplitter	*Potamilus alatus*
Pimpleback	*Quadrula pustulosa*
Threehorn wartyback	*Obliquaria reflexa*
Threeridge	*Amblema plicata*
Elephantear	*Elliptio crassidens*
White heelsplitter	*Lasmigona complanata*
Pistolgrip	*Tritogonia verrucosa*
Purple waryback	*Cyclonaias tuberculata*
Mapleleaf	*Quadrula*
Butterfly*	*Ellipsaria lineolata*
Giant floater*	*Pyganodon grandis*
Pink papershell*	*Potamilus ohiensis*
Flat floater*	*Anodonta suborbiculata*

* = collected as dead shells

3.10.3 Introduced Species

A nonindigenous water flea, *Daphnia lumholtzi*, has been documented throughout the Tennessee River system (Tyler Baker, TVA biologist, personal communication, 2001). It is therefore expected to occur in Wheeler Reservoir.

Asiatic clam and zebra mussel populations that exist within Wheeler Reservoir would not be prone to exacerbation or extirpation due to BFN's thermal discharge. Thermal discharge limits permitted by ADEM would not exceed thermal thresholds of both organisms. Asiatic clams cannot survive extreme ambient water temperatures less than 36°F (2.2°C) and greater than 95°F (35°C). Thermal tolerance of Zebra mussels is 32°F to 98.6°F (Nalepa and Schloesser,1993). Potential biofouling by zebra mussels would actually be reduced by thermal addition as mortality of 60 percent was reported by Nalepa and Schloesser, (1993) at 89.6°F. BFN treats their raw water intake biannually with molluscide to control biofouling by Asiatic clams and zebra mussels. In addition, biweekly Raw water samples are analyzed during April through October for zebra mussel veligers as an early warning for potential biofouling.

Grass carp have been introduced to reservoirs in the TVA system, both by individuals seeking to control heavy infestations of aquatic vegetation, and by TVA in Guntersville Reservoir. Grass carp have not been collected in high numbers; they were not included in cove rotenone samples taken through 1997, and have been taken infrequently in reservoir monitoring gill net and electrofishing samples (Table 3-10.1).

3.10.4 Entrainment and Impingement of Fish and Shellfish, Heat Shock

Fish eggs and larvae entrained in cooling water may suffer mortality from one or more physical effects of passage through the plant. Consequently, in conjunction with the construction of BFN, TVA investigated the preoperational characteristics and dynamics of the annual Ichthyoplankton populations in Wheeler Reservoir (TVA, 1978a). This investigation was continued through the initiation of commercial operation in 1974, and data from 1971-1977 were reported (TVA, 1978b); 1978 and 1979 data were also reported (TVA, 1980). The larval fish populations were consistently dominated (80-98%) by clupeids (shad). Total annual percent fish entrainment increased over the four-year study period from 1.0 to 11.7% of the total number estimated passing the plant. Other significant taxa comprising greater than one percent of the total number of larval fish collected were catastomids (suckers), cyprinids (minnows and carp), sciaenids (drum), and percichthyids (white and yellow basses). The three families of fish with the highest estimated entrainment during three-unit operation at BFN in 1977 were Clupeidae (12.1%), Catostomidae (4.5%) and Sciaenidae (6.1%).

Four species of fish (threadfin shad, gizzard shad, freshwater drum, and skipjack herring) represented 95% of the total fish impinged at BFN. No species other than these four comprised greater than 1% of total fish impinged (TVA, 1980).

TVA's Vital Signs monitoring program (TVA 2000) reported no obvious decline in the fish and benthic macroinvertebrate communities in Wheeler Reservoir and there is a balanced indigenous fish community.

Response of fish and other aquatic life to elevated temperatures found in power plant discharges can range from acute, which includes immediate disability and death; to chronic or low level, which may include physiological or behavioral responses such as changes in spawning, migration, or feed behaviors. Since the discharge diffusers at BFN are located such that fish do not become trapped in areas of elevated temperatures, acute impacts are highly unlikely. TVA studies have documented that thermal releases from BFN have not had a significant impact on the aquatic community of Wheeler Reservoir (TVA, 1983, Baxter and Buchanan, 1998).

3.10.5 Microbiological Organisms

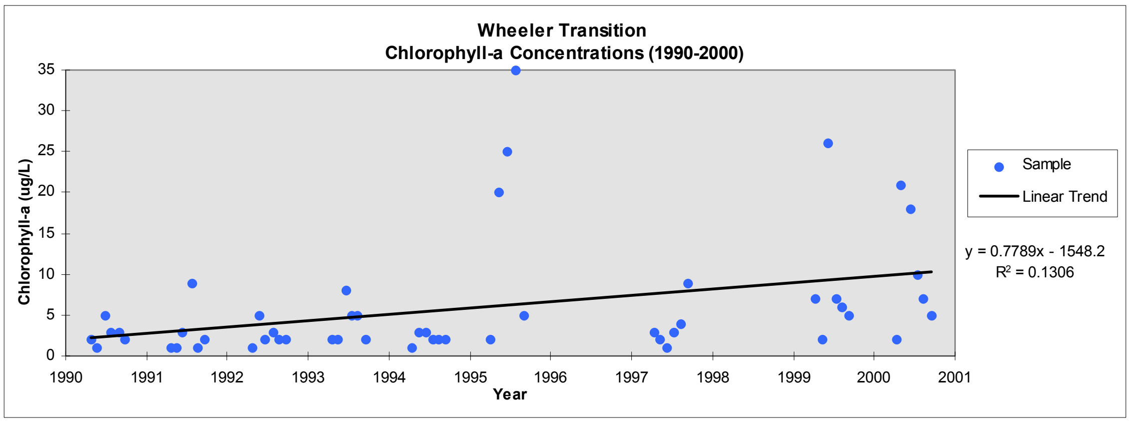
Plankton surveys were conducted during BFN preoperational monitoring in the early 1970s and have been a component of many BFN aquatic community surveys since then. The earliest phytoplankton surveys for Wheeler Reservoir found the assemblage to be quite diverse. As many as 27 Chrysophyta, 52 Chlorophyta, and 17 Cyanophyta taxa have been documented (TVA, 1977). Early zooplankton surveys documented a diverse assemblage as well, with 32 Dladocera, 24 Copepoda, and 47 Rotifera taxa represented (TVA, 1977). More recently, algal dynamics surveys were conducted in 1989 during plant shutdown and again in 1991 when the plant was operational as part of the approved BFN thermal variance monitoring program (Lowery and Poppe, 1992). The objective of this activity was to determine the effect the BFN thermal discharges would have on the phytoplankton community in Wheeler Reservoir. The study was initiated as a result of recommendations made during the operational monitoring reporting process for BFN.

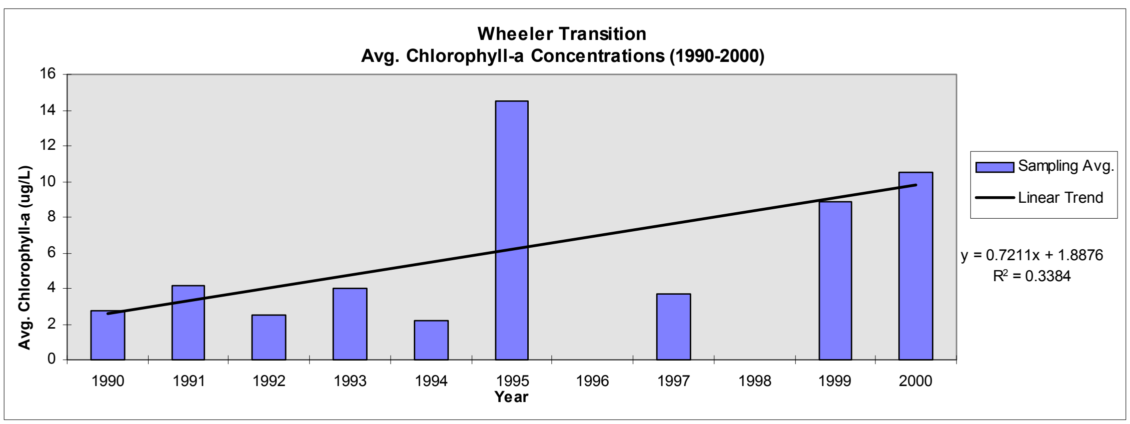
The validity of preoperational and operational BFN algal surveys conducted in the 1970s has been brought into question with advancements in reservoir limnology during the past 18 to 20 years. Considerable research and monitoring, conducted by TVA and others to evaluate phytoplankton/nutrient interactions in reservoirs has found that several factors must be considered to determine cause/effect relationships in reservoirs. These factors include flow-through conditions, overbank/embayment areas, residence time, zonation, and placement of point and non-point pollution sources (Lowery and Poppe, 1992). Erroneous results can occur when using annual "snapshot" surveys to analyze algal communities in reservoirs.

BFN preoperational and operational monitoring collections were typically conducted on an annual basis – once per summer. Vital Signs monitoring is conducted on a monthly schedule, April through September. Plankton data gathered during Vital Signs monitoring is believed to be more reliable. According to Lowery and Poppe (1992), the importance in sampling monthly lays in the fact that algal division rates are such that several generations can be missed in less frequent sampling and hence the chances for observing "boom or bust" situations increase as sampling frequency decreases. Unfortunately, abnormally high densities observed during operational monitoring may have been nothing more than chance collections, during peak densities just as lower numbers in other years may have been underestimates (Lowery and Poppe, 1992). If BFN is having a stimulatory or depressing effect on the plankton community in the near field, numbers should be significantly increased or decreased downstream of the plant in at least some habitats as compared to similar habitats. Examination of the 1989 and 1992 samples and the Vital Signs monitoring network data (far field) showed no consistent changes in either the near field or downstream (Lowery and Poppe, 1992). The only consistent observation that could be made from the 1989 and 1991 surveys and the Vital Signs monitoring data was that plankton communities vary on a daily basis regardless of location or habitat type.

Chlorophyll *a* is a simple, long-standing, and well-accepted measurement for estimating algal biomass, algal productivity, and trophic condition of a lake or reservoir (Carlson, 1977). Generally, lower chlorophyll concentrations in the oligotrophic range are thought to be indicative of good water quality conditions, and high chlorophyll concentrations are usually considered indicative of cultural eutrophication (Dycus and Baker, 2000). Average chlorophyll a concentrations (µg/L) recorded from Wheeler Reservoir's transition station between 1992 and 1999 are illustrated in Figure 3.10-1. Wheeler Reservoir's chlorophyll levels at the transition station, in the vicinity of BFN, received a "fair" rating in 1992 and 1994, a "good" rating in 1993, 1997, and 1999, and a "poor" rating in 1995 (TVA, 1993, 1994, 1995, 1996, 1998, Dycus and Baker, 2000). Low flow conditions in 1995 are believed to have allowed for longer water retention times in the reservoir contributing to increased algal production and a substantially lower score. For a detailed explanation of how chlorophyll a concentrations are translated into a rating, see Dycus and Baker (2000).

Figure 3.10-1 Chlorophyll *a* Concentrations from Wheeler Reservoir Transition Station, Vital Signs Monitoring 1990-2000





3.11 Threatened and Endangered Species

3.11.1 Animal

A review of TVA Regional Natural Heritage databases indicates that four federally- or state-listed species of animals are reported from Limestone County (Table 3.11-1). No listed species are reported within five miles of the BFN.

Table 3.11-1 Rare Terrestrial Animal Species Known from Limestone County, Alabama

Common Name	Scientific Name	Federal Status	State Status
Gray Bat	*(Myotis grisescens)*	Endangered	Protected
Indiana Bat	*(Myotis sodalis)*	Endangered	Protected
Tennessee Cave Salamander	*(Gyrinophilus palleucus)*	none	Protected
Appalachian Bewick's Wren	*(Thryomanes bewickii altus)*	none	Protected

Federally listed endangered gray and Indiana bats are reported from caves along the Elk River. Gray bats are monitored at these caves annually by ADC Biologists. Gray bat populations appear to be stable at these sites. Indiana bats have not been reported from these caves in recent years. Although there are no suitable habitats for gray or Indiana bats on the BFN, gray bats likely forage along the Tennessee River adjacent to the project area.

State-listed Tennessee cave salamanders and Appalachian Bewick's wren have been reported from northern portions of Limestone County. No caves are known from the project area; therefore, no suitable habitat for Tennessee cave salamanders exists on the site. Appalachian Bewick's wren prefers nesting in hedgerows or slash piles in early successional habitat. Limited amounts of this habitat exist on the site; however, the quality of this habitat is considered marginal.

3.11.2 Aquatic

Five federally listed endangered aquatic species are known to occur in the vicinity of BFN. The rough pigtoe (*Pleurobema plenum*) and the pink mucket (*Lampsilis abrupta*) are freshwater mussels that historically occurred in silt-free, stable gravel and cobble habitats in large river habitats throughout the Tennessee River system (Parmalee and Bogan, 1998). These species are now extremely rare and are primarily found in unimpounded tributary rivers and in the more riverine reaches of the largely impounded mainstream Tennessee River. In Wheeler Reservoir, most of the surviving large river habitat occurs upstream of BFN. All recent records of these two species are from upstream of BFN (Ahlstedt and McDonough, 1993; Colaw and Carroll, 1982; El-Ashry and Lesene, 1979; Jeffrey T. Garner - State Malacologist - Alabama Game and Fish Division, personal communication 1998 and 2001; Gooch, et al., 1979; Henson and Pryor, 1982; TVA Regional Natural Heritage Database, 2001; Yokely, 1998). It is very unlikely that populations of these species exist in Wheeler Reservoir downstream of BFN (Koch, 1999).

Two aquatic snails, restricted to streams entering Wheeler Reservoir in Limestone County, Alabama, were recently listed as endangered by the U. S. Fish and Wildlife Service. The armored snail (*Pyrgulopsis pachyta*) and the slender campeloma (*Campeloma decampi*), as well as the previously listed Anthony's river snail (*Leptoxis* [=*Athearnia*] *anthonyi*), are restricted to tributary creeks to Wheeler Reservoir, located upstream from BFN. No evidence exists to suggest that populations of these species exist in Wheeler Reservoir downstream of BFN.

Other federally-listed species, such as the orange-footed pimpleback mussel (*Plethobasus cooperianusi*), the cracking pearly mussel (*Hemistena lata*), the fine-rayed pigtoe mussel (*Fusconaia cuneolus*), the shiny pigtoe mussel (*F. cor*), Snail darter (*Percina tanasi*), the slackwater darter (*Etheostoma boshungi*), the boulder darter(*E. wapiti*), and the Alabama blind cave shrimp (*Palaemonias alabamae*) are known to occur in the general North Alabama area (i.e., Limestone, Lawrence, and Morgan Counties, Alabama). None of these species are presently known to exist within the area affected by the proposed actions.

3.11.3 Plants

A review of the TVA Regional Natural Heritage database indicates that no federally listed and five Alabama state-listed plant species are known from Limestone County, Alabama (Table 3.11-2). A more detailed review of TVA Heritage records indicates that none of these species, or any other rare plant species known from adjacent counties, are known to occur within five miles of the project area. In addition, field inspections of the project area reveal that suitable habitats for these or other rare plant species are not present on lands to be affected by the proposed activities.

Table 3.11-2 Rare Plant Species Known from Limestone County, Alabama

Common Name	Scientific Name	Federal Status	State Status[†]
Duck River bladderpod	*Lesquerella densipila*	none	NOST
Snow wreath	*Neviusia alabamensis*	none	NOST
Sweetflag	*Acorus calmus*	none	NOST
Toadshade*	*Trillium sessile*	none	NOST
Waterweed	*Elodea canadensis*	none	NOST

[†] NOST - Alabama Natural Heritage Program does not assign status codes to state-listed species; this designation indicates the species is tracked by the Alabama Natural Heritage Program due to its rarity in the state.

* This common name is often applied to more than one member of this genus.

3.12 Wetlands

Wetland resources in Alabama have suffered a marked decline as the result of channelization of major streams and the clearing of wetlands for agricultural and other purposes. Past land-use changes and stream channelization have resulted in the reduction of total wetland acreage, changes in wetland types, and diminished ecological integrity of many of the remaining wetlands throughout the region. Channelized streams result in less frequent flooding and allow rapid runoff and drainage of the floodplain and adjacent areas. The extensive areas of bottomland forested wetlands that occurred in the major stream bottoms prior to channelization and land clearing are largely absent from the landscape. Overall, Alabama sustained a net loss of 42,000 acres out of 2.7 million acres between 1974 and 1983. The greatest losses were due to the conversion of forested wetlands to non-wetland or other wetland types (Heffner, et al., 1994). Since 1983 wetland losses have slowed, although urbanization and impacts associated with transportation construction projects still impact wetlands in the state (Flynn, 2001).

WETLANDS IN THE PROJECT AREA

Wetlands in the vicinity of BFN are a mix of habitat types, including palustrine forested wetlands, scrub-shrub wetlands, and emergent wetlands associated with the mainstream of the Tennessee River/Wheeler Reservoir. These areas occur primarily along embayments of the main channel. There are also wetlands associated with various tributary streams in the project area, including Douglas Branch, Poplar Creek, Dry Creek, and Round Island Creek. Wetlands in these areas are generally confined to narrow strips of forested or scrub-shrub wetlands along the stream channel and many have been reduced both in extent and function due to clearing and channelization associated with agricultural activities.

National Wetland Inventory (NWI) maps indicate small areas of palustrine emergent and scrub-shrub wetlands occur within the boundaries of BFN, and in the areas proposed for disposal of spoil materials associated with construction. A field survey verified the presence of a palustrine emergent wetland within the boundaries of an excavated unnamed stream channel draining agricultural fields at the northeast boundary of the plant boundary. This area is within the plant boundaries, but not within the areas proposed for disturbance. Vegetation consists of soft rush (*Juncus effusus*), blunt spike rush (*Eleocharis obtusa*), and fescue (*Festuca* spp.). The NWI also indicates a palustrine emergent/scrub-shrub wetland in low-lying agricultural area in the northeast boundary of the plant, in an area proposed for spoil disposal. However, a field survey indicated that this area has been excavated and cleared by agricultural activities to the extent that wetland characteristics are absent from this area.

3.13 Socioeconomic Conditions

3.13.1 Demography

Estimated 2000 population in Limestone County is 65,676, an increase of 21.3% since 1990 and 57.5% since 1970. This growth is much faster than the LMA, the state, or the nation. The LMA includes Colbert and Lauderdale Counties (Florence Metropolitan Area), Lawrence County, Madison County (Huntsville), and Morgan County (Decatur). Total population in the LMA in 2000 was 631,193, an increase of 13.5% since 1990 and 40.1% since 1970, higher than the state and slightly higher than the national growth rate.

The population of Limestone County is projected to reach more than 80,000 by 2015, with a labor market population of over 748,000 at that time. These projections are based on a continuation of growth rates experienced over the last three decades, except for Colbert County, which is projected to continue the growth turnaround experienced since 1990.

Table 3.13-1 Population and Population Projections						
	1970	**1980**	**1990**	**2000**	**2010**	**2015**
Limestone Co.	41,699	46,005	54,135	65,676	74,831	80,762
Colbert Co.	49,632	54,519	51,666	54,984	58,515	60,365
Lauderdale Co.	68,111	80,546	79,661	87,966	95,133	98,799
Lawrence Co.	27,281	30,170	31,513	34,803	37,405	38,881
Madison Co.	186,540	196,966	238,912	276,700	313,143	335,444
Morgan Co.	77,306	90,231	100,043	111,064	126,346	134,093
LMA	450,569	498,437	555,930	631,193	705,373	748,344
Alabama (000)	3,444.4	3,894.0	4,040.4	4,447.1	4,816.5	5,014.0
U. S. (000)	203,302.0	226,545.8	248,790.9	281,421.9	311,318.1	328,413.3

Source: Historical data from U. S. Department of Commerce, Bureau of the Census. Projections by TVA.

Table 3.13-2 Population Growth Rates				
	1970-2000	**1990-2000**	**2000-2010**	**2000-2015**
Limestone Co.	57.5	21.3	13.9	23.0
Colbert Co.	10.8	6.4	6.4	9.8
Lauderdale Co.	29.2	10.4	8.1	12.3
Lawrence Co.	27.6	10.4	7.5	11.7
Madison Co.	48.3	15.8	13.2	21.2
Morgan Co.	43.7	11.0	13.8	20.7
LMA	40.1	13.5	11.8	18.6
Alabama (000)	29.1	10.1	8.3	12.7
U. S. (000)	38.4	13.1	10.6	16.7

3.13.2 Economic Conditions

Limestone County had a total labor force of 29,524 persons on average during 2000, while the labor force in the LMA was almost 316,000. The unemployment rate in the LMA was 3.9%, below the state average and slightly below the national average. Limestone County, itself, had a lower rate of unemployment, 3.3%, well below the state average. These rates of unemployment meant that almost 1,000 persons in Limestone County and over 12,000 in the LMA were unemployed.

Table 3.13-3 Labor Force and Unemployment, 2000			
	Civilian Labor Force	**Number Unemployed**	**Unemployment Rate**
Limestone Co.	29,524	971	3.3
Colbert Co.	25,531	1,606	6.3
Lauderdale Co.	41,381	2,258	5.5
Lawrence Co.	16,703	906	5.4
Madison Co.	145,450	4,101	2.8
Morgan Co.	57,195	2,338	4.1
LMA	315,784	12,180	3.9
Alabama	2,154,273	99,092	4.6
U. S. (000)	140,863	5,655	4.0

Source: Alabama Department of Industrial Relations, Employment Security Division, and U. S. Department of Labor, Bureau of Labor Statistics.

The number of jobs in Limestone County has more than doubled since 1970, reaching a total of 29,035 jobs in 1999. This 1999 level is 6.8% higher than in 1990. Growth since 1970 has been faster than the LMA, the state, and the nation. However, since 1990 the rate of growth was much slower than the LMA, the state, or the nation. On the other hand, as discussed above, population grew faster since 1990 as well as over the longer term. This suggests that over the last several years, Limestone County has become more of a bedroom community to Huntsville as its growth has continued to spread toward the west.

The LMA grew more slowly from 1990 to 1999 than did the state and the nation, although it grew more rapidly than either during the overall time period since 1970.

Limestone County is more dependent on manufacturing, government, and farm employment than the LMA, the state, or the nation and less dependent on trade and services employment. The LMA has an industrial distribution similar to that of the state as a whole, although it is slightly more dependent on manufacturing. The state as well as the LMA is more dependent on manufacturing and less on trade and services employment than is the nation as a whole.

Based on the population projected above and on the TVA forecasts of employment for the TVA Power Service Area, employment in Limestone County is expected to be around 41,000 at the time of current license expiration, and close to 58,000 by the time a 20-year license extension would expire. The LMA is projected to exceed 434,000 jobs and 535,000 jobs, respectively, by these dates.

Table 3.13-4 Total Employment (Full-time and Part-time), by Place of Work						
	1970	1980	1990	1999	Percent Change, 1970-99	Percent Change, 1990-99
Limestone Co.	14,056	18,300	27,188	29,035	106.6	6.8
Colbert Co.	25,045	29,775	28,594	29,039	15.9	1.6
Lauderdale Co.	20,518	29,126	36,579	42,978	109.5	17.5
Lawrence Co.	7,289	8,905	11,445	12,102	66.0	5.7
Madison Co.	93,110	108,507	165,710	192,297	106.5	16.0
Morgan Co.	34,144	42,699	54,151	64,397	88.6	18.9
LMA	194,162	237,312	323,667	369,848	90.5	14.3
Alabama	1,412,924	1,735,999	2,061,914	2,409,612	70.5	16.9
U. S. (000)	91,281.6	114,231.2	139,426.9	163,757.9	79.4	17.5

Source: U. S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Information System.

Table 3.13-5 Projected Total Employment, 2015 and 2035					
	1999	2015	2035	Percent Change, 1999-2015	Percent Change, 1999-2035
Limestone Co.	29,035	41,469	58,013	42.8	99.8
Colbert Co.	29,039	32,294	36,931	11.2	27.2
Lauderdale Co.	42,978	51,879	61,519	20.7	43.1
Lawrence Co.	12,102	19,047	23,497	57.4	94.2
Madison Co.	192,297	215,961	262,638	12.3	36.3
Morgan Co.	64,397	73,470	93,004	14.1	44.4
LMA	369,848	434,120	535,602	17.4	44.8

Source: Projections by TVA.

Table 3.13-6 Percent Distribution by Industry Employment (Full-time and Part-time), by Place of Work, 1999						
	Total	Farm	Manufac-turing	Trade and Services	Govern-ment	Other
Limestone Co.	29,035	7.7	22.4	37.6	20.3	12.1
Colbert Co.	29,039	3.3	15.7	42.6	20.4	18.0
Lauderdale Co.	42,978	5.1	16.8	48.1	16.9	13.1
Lawrence Co.	12,102	16.4	21.1	29.8	14.0	18.7
Madison Co.	192,297	1.7	15.4	51.6	19.3	12.0
Morgan Co.	64,397	3.2	23.6	43.6	11.8	17.8
LMA	369,848	3.4	17.8	47.3	17.7	13.8
Alabama	2,409,612	3.5	15.7	47.2	16.0	17.6
U. S.	163,757.9	3.2	11.8	52.5	13.6	18.9

Note: Percentages may not add to 100 due to rounding.
Source: U. S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Information System.

Per capita income in both Limestone County and the LMA declined relative to the state and the nation between 1989 and 1999. In 1989, per capita income in Limestone County was 79.3% of the national average, but in 1999 the percentage had declined to 74.6%; in the meantime, the state had grown slightly relative to the nation. In a similar pattern, per capita income in the LMA was 90.6% of the national average in 1989, but only 85.8% in 1999. None of the counties in the LMA had average income above the national average in 1999, although Madison County did in 1989. Both Madison and Morgan Counties had average incomes higher than the state average in 1999, as well as in 1989.

Table 3.13-7 Per Capita Personal Income

	Per Capita Personal Income, 1989	Per Capita Personal Income, 1999	Percent of Nation, 1989	Percent of Nation 1999
Limestone Co.	14,714	21,294	79.3	74.6
Colbert Co.	14,260	22,550	76.8	79.0
Lauderdale Co.	14,587	21,036	78.6	73.7
Lawrence Co.	11,952	20,691	64.4	72.5
Madison Co.	19,223	27,049	103.5	94.8
Morgan Co.	16,858	24,585	90.8	86.1
LMA	16,812	24,498	90.6	85.8
Alabama	14,899	22,972	80.2	80.5
U. S.	18,566	28,546	100.0	100.0

Source: U. S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Information System.

3.13.3 Community Services and Housing

Limestone County is a fast-growing county and a part of the Huntsville metropolitan area. As such, it has experienced relatively fast growth in housing and in the provision of government and other local services. It is also adjacent to the central metropolitan counties of Madison (Huntsville), Morgan (Decatur), and Lauderdale (Florence). These counties have well-developed community services and housing markets. Schools, fire and police protection, and medical services have all been exposed to growth and change in their communities in recent years, as have the local housing markets.

3.13.4 Environmental Justice

Minority population in Limestone County and in the LMA is a smaller share of the total than in the state or the nation. Limestone County has a minority population of 11,534, some 17.6% of the total, while the LMA has a minority population of 139,362, some 22.1% of the total. Poverty levels in both Limestone County and in the LMA as a whole are below the state average. For the LMA as a whole, the poverty rate is also lower than the national average, while the rate in Limestone County is about the same as the national average.

Table 3.13-8 Minority Population, 2000, and Percent Below Poverty Level, 1997				
	Total Population	Minority Population	Percent Minority	Percent Below Poverty Level
Limestone Co.	65,676	11,534	17.6	13.5
Colbert Co.	54,984	10,514	19.1	13.5
Lauderdale Co.	87,966	10,726	12.2	13.3
Lawrence Co.	34,803	7,904	22.7	15.7
Madison Co.	276,700	80,204	29.0	11.0
Morgan Co.	111,064	18,480	16.6	11.4
LMA	631,193	139,362	22.1	12.1
Alabama	4,447,100	1,321,281	29.7	16.2
U. S.	281,421,906	86,869,132	30.9	13.3

Source: U. S. Bureau of the Census.

BFN is located in Census Tract 211, not far from Census Tract 204.01. According to the 2000 Census of Population, 35.0% of the population in Tract 211 and only 8.6% of the population in Tract 204.01 is minority.

3.14 Transportation

3.14.1 Highways and Roads

The site is located approximately ten miles southwest of Athens in northern Alabama in Limestone County and is located just south of U. S. Highway 72, which runs from South Pittsburg, Tennessee, west to Memphis, Tennessee. The site is directly accessible from County Road 25. County Road 25 (Shaw Road) intersects U. S. Highway 72 approximately six miles north of the site. County Road 25 (Nuclear Plant Road) also intersects U. S. Highway 31 approximately nine miles east of the site. U. S. Highway 31 intersects U. S. Highway 72 northeast of the site. Browns Ferry Road to County Road 25 just east of the site provides a more direct route to the site from Athens. U. S. Highway 72 and U. S. Highway 31 are both high quality four-lane routes with good lane widths, alignments, turning lanes, and speed limits of 50 miles per hour (mph) through Athens and increasing away from the city. County Road 25 and Browns Ferry Road are medium quality two lane roads with level alignment, some passing zones, and speed limits of 45 mph. Direct accessibility into the plant facility off County Road 25 is good. The large diamond intersection at one entrance allows for smooth turning movements into and out of the plant. Another access road into the plant commonly used by contractors utilizes a traffic light at the intersection with Nuclear Plant Road.

The primary traffic generator in the vicinity of the site is the nuclear plant. BFN currently averages a daily site population of approximately 1,200 persons. The population currently peaks at approximately 2,000 persons during outages, which occur every 24 months (per unit) for approximately two months. Current truck deliveries are minimal (less than ten per week) and include hydrogen trucks, Calgon water chemistry trucks, and occasional diesel fuel deliveries during peak months. Rural residences located along the county roads that provide access to the site are also traffic generators in the area.

Figure 3.14-1 shows a map of the local road network for the area. The latest available 1998 Average Daily Traffic (ADT) counts in close proximity to the site indicate approximately 13,440 vehicles per day (vpd) on U. S. Highway 72 north of the site and 16,260 vpd on U. S. Highway 31 south of U. S. Highway 72. There are no available traffic counts on the county roads; however, TVA estimates approximately 1,600 vpd on Shaw Road, Browns Ferry Road, and Nuclear Plant Road.

3.14.2 Railroads

Direct rail access does not serve BFN. A railway spur track and unloading area is located off the CSX mainline which runs north and south in Tanner, Alabama, approximately eight miles east of BFN. TVA leased this small parcel of land from CSX (Louisville and Nashville Railroad) and used it for offloading during construction of the plant; however, TVA has not used this area for offloading and transporting materials to the plant since then. After offloading, heavy items were transported on heavy trucks via a "hardened" pathway to the site that included shallow fords through creek beds along the way. At the site itself a short railroad spur runs into the turbine building for transport into the plant.

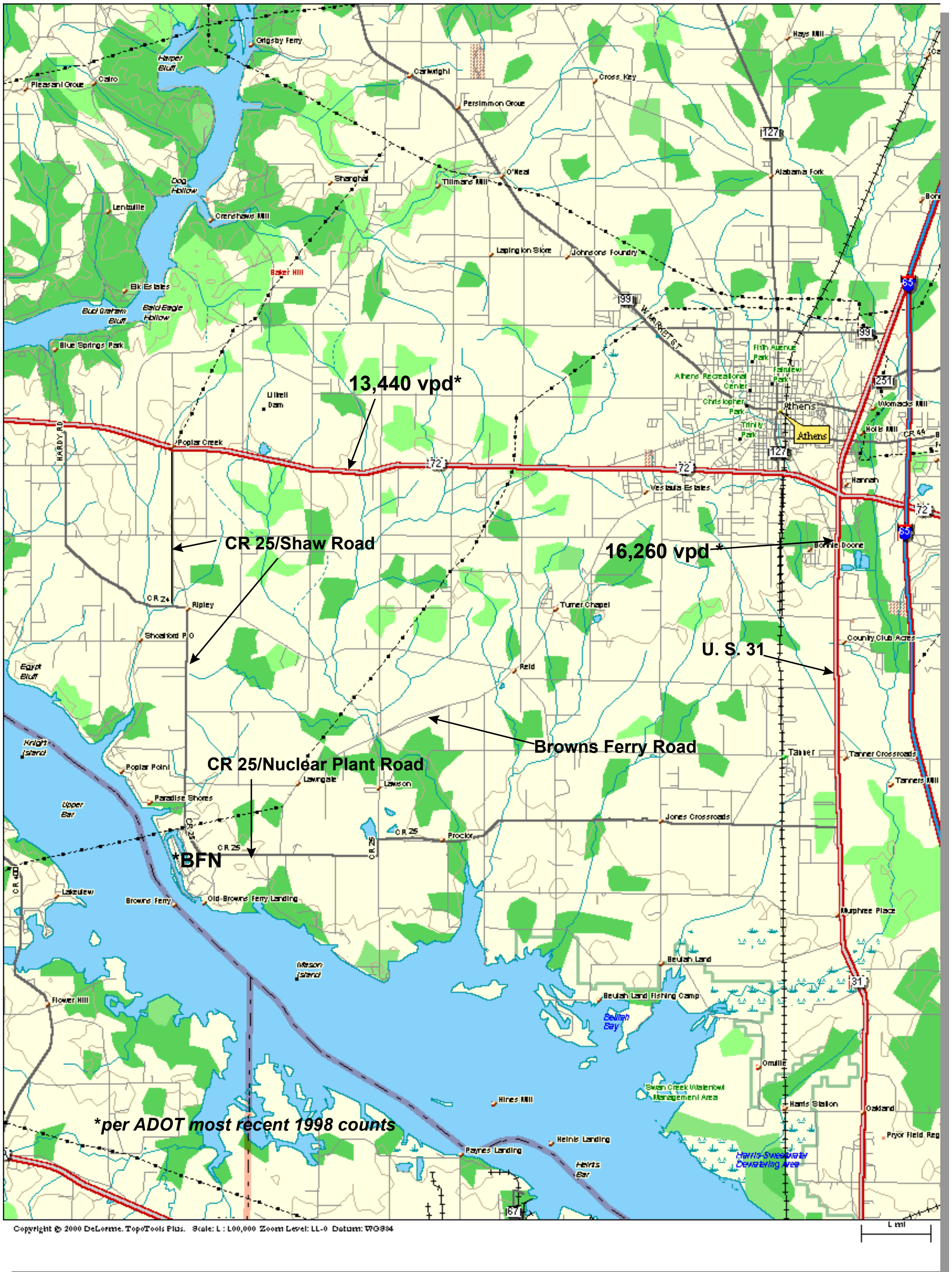
The railroad spur track and unloading area is currently planned for future removal off site of dry cask spent fuel storage canisters. There are no plans to use it for Unit 1 refurbishment or regular plant operations.

3.14.3 River Transport

BFN is located along the Tennessee River at approximately TRM 294. Guntersville Lock and Dam are located 55 miles upstream from the site and Wheeler Lock and Dam are located 20 miles downstream from the site. Traffic on the Tennessee River near BFN includes both commercial and recreational vessels. The locks and channels are more than adequate in handling river traffic. Both Guntersville Lock and Wheeler Lock are operating below their utilization capacity.

BFN has a qualified barge facility near the northwest corner of the site. Currently it consists of barge tie points and a wide ramp going down into the water. The ramp was used during initial plant construction for very heavy loads such as reactor vessels. The barge facility is currently used several times per year, but each usage requires a temporary crane. The roadbed from the plant to the barge facility is "hardened" for heavy loads. Future work is contemplated to upgrade the barge facility by stabilizing the riverbank and installing anchoring cells and a permanent dock (so that the facility will no longer require use of a temporary crane). An upgraded barge facility could eventually be used to transport spent fuel canisters offsite for disposal in a national repository. The barge facility would likely be used for some heavy items during Unit 1 refurbishment; however, this upgrade is independent of any decision on refurbishing Unit 1. Appropriate environmental analyses would be done if TVA decides to propose upgrading the barge facility.

Figure 3.14-1 Local Road Network for BFN



3.14.4 Pipelines

Three pipelines pass within five miles of the center of the BFN plant site. One is an eight-inch line carrying xylene at a maximum pressure of 175 pounds per square inch (psi); it runs north and south and passes about 2.4 miles east of the plant. The other two carry natural gas in a common right-of-way about 3.8 miles south-southwest of the plant. They run generally east-west. One line is eight-inch and the other 12-inch and both have a maximum pressure of 600 psi.

The only pipeline crossing the BFN site boundary is a ten-inch potable water line from the Athens Water District. There are no plans to install or connect to any pipelines in the foreseeable future.

3.14.5 Transmission Lines

The BFN is connected into the TVA system network by seven 500-Kilovolt (kV) lines. One line is to Madison substation, two to Trinity substation, one line each to the West Point, Maury, and Union substations, and one line to the Limestone 500-kV Substation. Any three lines excluding more than one Trinity line can transmit the entire station output into the TVA system network.

Normal station power is from the unit station service transformers connected between the generator breaker and main transformer of each unit. Startup power is from the TVA 500-kV system network through the 500- to 20.7-kV main and 20.7- to 4.16-kV unit station service transformers. Auxiliary power is available through the two common station service transformers that are fed from two 161-kV lines supplying the 161-kV switchyard, one line each from the Athens and Trinity substations.

3.15 Soil and Land Uses

3.15.1 BFN Environs

Limestone County is part of the Highland Rim section of the Interior Low Plateaus physiographic province. It is comprised of three physiographic subdivisions: The Limestone Valleys, the Plateau, and the Alluvial Plains. The Limestone Valleys, locally called the red lands, include the southeastern part of the county. The Alluvial Plains include the nearly level to undulating first bottoms and stream terraces along the Tennessee and Elk Rivers. BFN is located in the Limestone Valleys and Alluvial Plains (USDA, 1953).

The soils that have developed in the Limestone Valleys and Alluvial Plains are inherently productive for growing crops. Those that developed from high-grade limestone originally contained a relatively high quantity of organic matter, and the depth of soil over bedrock is 15 to 20 feet in most places. Drainage is good and the acidity is moderate. The alluvial soils are fairly well supplied with lime, organic matter, and plant materials, which provide fertility needed to obtain high crop yields (USDA, 1953).

There are about 279,229 acres (73.5%) of soils in the county classified as prime and/or statewide important farmland (USDA-NRCS, 1979). These are soils that have the chemical and physical properties to economically sustain high yields of crop production.

Soils comprising the majority of the region immediately surrounding the BFN and including the site are Abernathy, Cumberland, and Decatur soils. Phases of these soils that occur on slopes less than 6% are classified as prime farmland. The Abernathy soils have developed from colluvial material washed from surrounding soils of high-grade limestone. This well-drained soil occupies mainly basins or depressions. The Cumberland soils are located on the river and stream banks and have developed from alluvium material washed from soils underlain by limestone and to a small extent by shale and sandstone. This soil is well adapted to cultivated crops because of its fertility and physical characteristics. The Decatur soils have developed from residual material weathered from high-grade limestone of the Tuscumbia formation. It is well suited for cropping and is one of the most extensively cropped soils in the county. (USDA, 1953).

Most of the soil on the BFN site was disturbed when the plant was constructed and is no longer considered as prime farmland. The entire site is classified as urban built-up land.

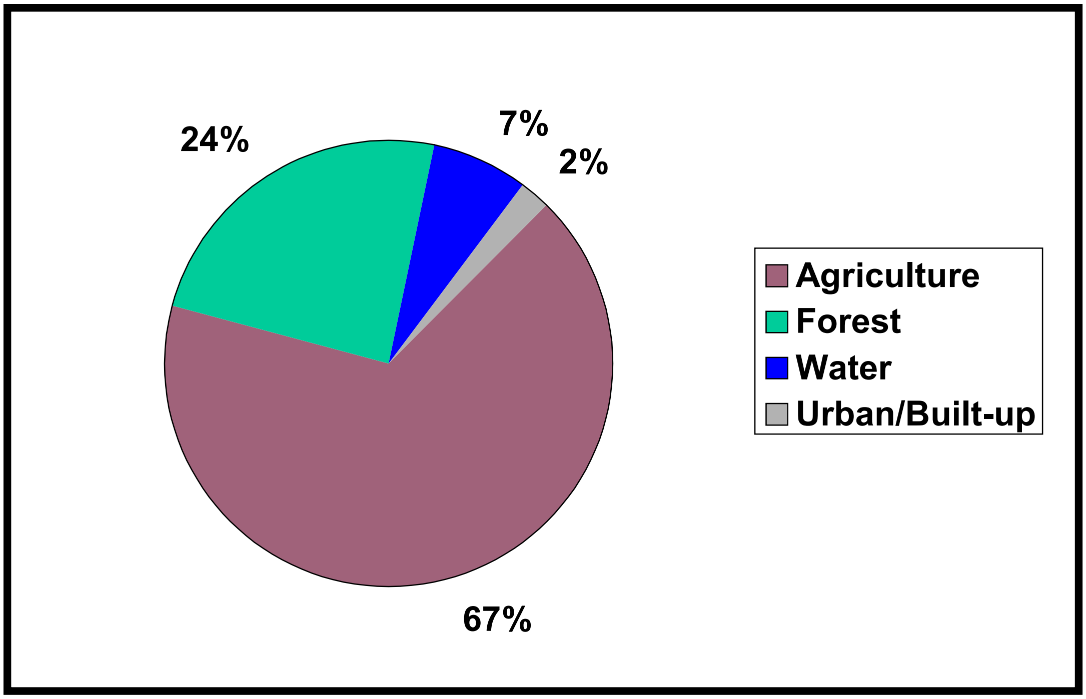
3.15.2 Past and Existing Land Uses (Including Offsite)

BFN is located in an agricultural area, surrounded by cropland planted with cotton. About 66.8% of the total acreage in the county is used for agriculture, the highest in Alabama (Figure 3.15-1). There are an estimated 78,900 acres (23.9%) of land in forest. The majority of the forestland is located in the northern two-thirds of the county. Trends show that land used for forest has been declining since the early sixties. During the sixties, thousands of acres were cleared for agriculture and other land uses associated with population growth (Limestone County Comprehensive Plan, 1985). Cropland has increased from 166,841 acres in 1987 to 181,292 acres in 1997 (USDA-NRCS).

Limestone County is ranked first in Alabama for the most cotton grown. In 1999, 69,200 acres of cotton were harvested, a total production yield of 79,000 bales. There were 6,400 acres of corn harvested, 16,500 acres of soybeans, 10,000 acres of wheat, and 24,000 acres of hay. Agriculture Census data for the county lists crop production cash receipts at $31,614,000. Livestock and poultry receipts were $21,905,000. Agriculture is, and will continue to be, a major economic component in the county.

From the 1994 EPA land use database (Figure 3.15-1), only about 2% of the county is urban built-up land. The current trend in population growth will promote a larger amount of land to become urbanized. Population growth for Limestone County from 1980 to 1990 was 17.7%. Athens City had a population increase of 17% from 1990 to 1998. These trends are attributable to the increased employment opportunity in the county as well as in nearby Huntsville and Decatur. During the last part of the 1980's, unprecedented growth in industrial employment occurred in each of the four outlying counties. Madison County also added thousands of new manufacturing jobs, but the change was most noticeable in the predominantly rural counties, such as Limestone. This trend in Limestone County suggests that a new era of economic development has already begun. Most of the residential development is occurring in the eastern portion of the county in the Capshaw French Mill area. There is also a significant number of new dwellings in the Browns Ferry Road area. It is expected that the majority of residential growth will occur around the City of Athens and the Elkmont Village area (Limestone County Comprehensive Plan, 1985). Development of commercial property is rapidly occurring in the area of intersection of U. S. Highway 72 and U. S. 65 and along the U. S. Highway 72 corridor to Huntsville.

Figure 3.15-1 Land Use in Limestone County



Source: EPA 1994

3.15.3 Land Use Planning and Controls

Limestone County, as part of Top of Alabama Regional Council of Governments, developed a Comprehensive Plan in 1985 to cover the period to year 2000 (Limestone County Comprehensive Plan, 1985). The vision of the Plan includes goals for land use, community facilities, transportation, and a capital improvements program and budget. The Plan has not been updated, but the same vision is reflected in the "Vision 2000, Strategic Agenda" document prepared by the Limestone County Vision 2000 Quality Council in March 2000.

The goal of the Land Use Plan was to achieve a balance among various land uses to accommodate a diversity of total life styles which will fulfill the requirements of county residents. The Plan has three objectives. The first is to promote a variety of housing types and a high level of efficiency in residential development patterns. The second is to promote the spatial distribution of various land uses that will result in a compatible relationship of land use activities. The third objective is to provide land for a wide variety of employment opportunities for the residents. The implementation of these objectives would provide utilities, services, and transportation to achieve the desired land use developments.

3.16 Visual Resources

The physical, biological, and cultural features seen in the landscape give a geographic area its distinct visual character and sense of place. Varied combinations of these elements make the visual resources of an area identifiable and unique. Scenic integrity indicates the degree of intactness, unity, or wholeness of the visible landscape. Aesthetic considerations include scenic beauty, scale, contrast, harmony, color, density, noise, and other qualities that affect the sense of place. Views of the affected landscape are described in terms of foreground, middleground, and background distances. Foreground is considered the area within a half-mile of the observer where details of objects are easily distinguished in the landscape. Middleground is the zone between foreground and background, normally between a mile and four miles from the observer. The objects may be distinguishable, but their details are weak and they tend to merge into larger patterns. Background is the distant part of the landscape, where objects are not normally discernible unless they are especially large and standing alone. Details are generally not visible and colors are lighter.

BFN is located off of County Road 25 (Nuclear Plant Road) approximately twelve miles south of Athens, Alabama. The site is surrounded to the north and east by rural countryside. It includes open pasturelands, scattered farmsteads, few residents, and little industry within several miles. The terrain is gently rolling with open views to higher elevations to the north. Little traffic is seen along the roadway except at plant shift changes and during deliveries. The south and west side of the plant site abuts Wheeler Reservoir, which is a wide expanse of open river used for an array of recreational purposes. Elevations across the plant site and in the surrounding areas rise gradually from 558 feet above sea level at the north shore of Wheeler Lake to around 800 feet above sea level ten miles north in the vicinity of Athens. The average elevation of the plant site is 575 feet above sea level. Scenic integrity is moderate, contrasting occasionally with homes that have lake views from across the river.

Access to the plant site is from Browns Ferry Road to County Road 25 from State Route (SR) 72 in Athens. The 600-foot high off gas stack comes into view over existing tree lines while traveling along Browns Ferry Road. Closer to the plant site, near County Road 25, the plant site comes into view. The site has remarkable contrast to the mostly rural countryside that surrounds it. From this viewpoint, clusters of transmission lines and associated steel pole and tower structures can be seen in the foreground and near middleground. These features identify the power plant and its associated architecture and infrastructure as predominately industrial facilities with little transition from rural countryside.

There are no homes within foreground viewing distance to the north and east. However, there is a small residential development to the northwest, across Wheeler Reservoir southwest, and Mallard Creek public use area that has partial views of the plant site. The views from the homes northwest off of County Road 25 are of the existing mechanical draft cooling towers (approximately 60 feet in height), a portion of the 500-kV switchyard and the turbine and reactor building. A berm, graded during the initial construction of the plant site and containing approximately 3.3 million cubic yards of earth, lies adjacent to the hot and cool water channels and blocks views of the northern and eastern plant areas. The homes to the southwest and from the Mallard Creek area have views of the off gas stack, the cooling towers, and the turbine and reactor building. These views may be somewhat obscured in the early morning hours, particularly in the fall and winter, as heavy fogs rise from the warmer waters of the lake.

3.17 Recreation

There are no developed public recreation facilities located at the BFN site. Located directly across the Tennessee River from the site is Mallard Creek Recreation Area. This is a TVA-developed and operated area. It includes camping, picnicking, swimming beach, and a boat launch area. Approximately 3.5 miles upstream of BFN is Round Island Recreation Area, also developed and operated by TVA. It features facilities for camping, swimming, picnicking and boat launching. The reservoir in the vicinity of the plant site is moderately utilized by recreational boaters and fishermen.

Two managed areas are known to occur within three miles of the site. These areas have been recognized and are protected, to varying degrees, because they contain unique natural resources, scenic values, or public use opportunities. These areas are owned by TVA and presently managed by the ADC.

SWAN CREEK STATE WILDLIFE MANAGEMENT AREA

This wildlife management area includes over 3,000 acres of land and over 5,000 acres of water surrounded by numerous industrial facilities. Wooded lands and grassy pastures, occasionally interrupted by railroad tracts and transmission lines, provide one of the most important waterfowl management areas in the state of Alabama. Although the primary management focus is for waterfowl and small game hunting, this area is becoming increasingly important for migrating bird species. In addition, the area is increasingly utilized by bird watchers and other outdoor enthusiasts.

MALLARD-FOX CREEK STATE WILDLIFE MANAGEMENT AREA

Encompassing approximately 700 acres of land and 1,700 acres of water this wildlife management area is primarily utilized for small game hunting.

3.18 Cultural Resources

3.18.1 Archeological Resources

HISTORIC BACKGROUND OF THE PROJECT AREA

Prehistoric Period

Archaeological research has indicated prehistoric human occupation in north central Alabama has occurred from the Paleo-Indian to the Mississippian period. Archaeological periods are based on changing settlement and land use patterns and artifact styles. In Alabama, prehistoric chronology is divided into five broad time periods: Paleo-Indian, Archaic, Gulf Formational, Woodland, and Mississippian (Walthall, 1980; McNutt and Weaver, 1985). Each of these broad periods is further broken down into sub-periods (generally Early, Middle, and Late), which are also based on artifact styles and settlement patterns. Smaller time periods, known as “Phases,” are representative of distinctive sets of artifacts.

The Paleo-Indian period (12000-8500 B.C.) represents the first human occupation of the area. The settlement and land use pattern of this period was dominated by highly mobile bands of hunter/gatherers. Following the Paleo-Indian period, the Archaic period (8500-1200 B.C.) continued to represent a hunter/gatherer lifestyle. An increase in social complexity and the appearance of horticulture characterized the later part of the period. The settlement pattern during this period is characterized by spring and summer campsites situated along river ways that exploit riverine resources and dispersed fall and winter campsites in the adjacent uplands. It is during the Gulf Formational Period (1200-400 B.C.) when pottery first appears in north central Alabama. The Early Gulf Formational Period is a transitional period from the Late Archaic during which there is a continuance of Archaic Period settlement patterns but there are also influences from the Gulf Coastal area to the south. The Gulf Formational period in the lower Tennessee Valley begins with the Middle Gulf Formational period and is associated with Wheeler series, fiber-tempered pottery. The Late Gulf Formational Phase is associated with Alexander series, fiber- and sand-tempered pottery, and correlates with Early Woodland Period cultures elsewhere. Increased social complexity, reliance on horticulture and agriculture, and a continuation and fluorescence of ceramic technology characterize the Woodland Period (600 B.C. - 1000 A.D.). The increased importance of horticulture is associated with a less mobile lifestyle as suggested by semi-permanent structures. Residential base camps were located on flood plains and alluvial terraces with specialized procurement sites in the adjoining uplands. The Middle Woodland Period is classified by various Colbert and Copena components. The Late Woodland is associated with the Flint River and Baytown cultures. The Mississippian Period (900-1700 A.D.), the last prehistoric period in north central Mississippi, is associated with the pinnacle of social complexity in the Southeastern United States. In north central Alabama this period is characterized by permanent settlements, maize agriculture, and chiefdom level societies.

Historic Period

The Historic Period is represented by the settlement of Europeans, Euro-Americans, and African-Americans in the region and the subsequent removal of Native American tribes. The first recorded European encounter with Native American groups in northern Mississippi by Europeans was Hernado de Soto's expedition in 1540. Continued expeditions into the area by French, Spanish and English traders and explorers occurred during the 16th, 17th, and 18th centuries. Clashes between the native Creeks and Europeans continued through the 18th century. By the early 19th century, the Creeks were defeated by Jackson and forced to surrender their lands and leave the area. The first permanent Euro-American settlements occurred in the early 19th century and the area was predominately occupied by Euro-Americans and African-Americans. Subsistence and cotton farming characterized the region from the Antebellum period to the early 20th century. Industrialization and urbanization has characterized the region in the late 20th century.

TVA is mandated, under the National Historic Preservation Act (NHPA) of 1966, to protect significant archaeological resources and historic structures located on land affected by TVA undertakings. NHPA Section 106 [16 U.S.C. 470f] requires Federal agencies prior to taking action that implements an undertaking to:

1) Take into account the effects of their undertaking on historic properties; and
2) Afford the Advisory Council on Historic Preservation (ACHP) a reasonable opportunity to comment regarding such undertaking.

The State Historic Preservation Office (SHPO) serves as a proxy to the ACHP and consultation has been initiated with the Tennessee SHPO concerning the project alternatives and any potential affect to historic properties.

The determination that an action is an undertaking does not require knowledge that historic properties are present. An agency determines that a given proposal is an undertaking based solely on that proposal's inherent ability to directly or indirectly affect historic properties. The area of potential effects (APE) for an undertaking is usually defined for archaeological resources as any area where facilities would be situated and for historic structures as any area from which those facilities would be visible.

At the initiation of this proposal, TVA Cultural Resources staff considered the nature of the undertaking and determined that the project had the potential to affect historic properties should those be present in the area. The APE for archaeological resources was determined as the three areas designated as soil disposal or spoil pile locations. The APE for historic structures was determined as those areas from which the disposal locations would be visible.

A Phase I survey was conducted at the three disposal site/spoil pile locations. This survey identified two historic properties. The survey of Area 1 (see Figure 2.2-7) identified a prehistoric archaeological site with an Early to Middle Woodland occupation. This site is considered potentially eligible for listing in the National Register of Historic Places. Cox Cemetery was identified in Area 2. This cemetery was relocated during the initial construction of the BFN. No historic properties were identified in Area 3.

3.18.2 Historical Structures

An architectural survey was conducted within the visual APE of the proposed project area. No historic structures were identified.

3.19 Environmental Noise

3.19.1 Introduction

Areas that are potentially affected by environmental noise from typical industrial operations are usually within a mile radius of the noise source(s). Sometimes effected areas can reach to two miles under special conditions that are favorable to outdoor sound propagation. This evaluation is primarily concerned with the potential environmental noise effects of the addition and replacement of cooling towers in Alternative 2. Although there are only a couple of residences within the one-mile radius of the center of the main-plant building, there are many residences within a mile of the cooling tower area. Also, within two miles is the Lakeview Community across the river. The open path across water is favorable to sound propagation toward Lakeview. The following sections present a more detailed description of the potentially affected areas; the regulations, standards, and guidelines concerning environmental noise; the possible effects that environmental noise might have on people; and the current noise environment in the area.

3.19.2 Potentially Affected Areas

As anticipated, there has been substantial change in the character of some of the areas surrounding BFN subsequent to the release of the original EIS. Generally, the number of residences and population along the waterfront have increased and the industrial activity on and along the river has also increased.

Upstream and adjacent to the BFN property are new developments of waterfront homes. (Pointe Westmoreland and Lookingbill subdivisions). There are about 40 residences along approximately 4,400 feet of riverfront. The nearest house is within 100 feet of the BFN property line on the east side. These residences are more than a mile from the closest cooling towers 1 and 6, and there is a small hill and the main plant in between this residential area and the cooling towers. Also, there are no favorable conditions for sound propagation in this direction. For these reasons, this residential area is not considered sensitive to environmental noise.

Downstream and adjacent to the BFN property and adjacent to cooling tower area is an older waterfront community, Paradise Shores. This area had few residences in-place when the plant was built, and it is currently a mix of year-around and recreational homes. There are about 100 residences within one mile of the closest cooling towers, and some are as close as 1,500 feet. Paradise Shores is a medium to high density suburban area. This is an area that could be sensitive to environmental noise.

The Lakeview Community is across the river and approximately 8,500 feet from the center of the cooling tower area. It is primarily year-around homes with a few recreation residences. Most of these were built after BFN was constructed. As mentioned in the Introduction, this area could be sensitive to environmental noise because of the favorable sound propagation characteristics across water.

The areas northeast of BFN are still agricultural as they were when the plant was built. There are no residential developments within a mile of the cooling tower, and these areas are not considered sensitive to environmental noise.

3.19.3 Noise Regulations, Ordinances, Guidelines, and Other Useful Criteria

Generally, environmental noise regulations, ordinances, guidelines, and other criteria are set for two reasons. First, to protect the existing residents from the potential impact of new noise sources; and second, to protect new residents from the existing noise sources. The guidelines from the U. S. EPA found in its "levels" document (EPA, 1974) and most municipal noise ordinances (Gatley, 1979) address the first reason. Also, the Federal Interagency Committee on Noise (FICON, 1992) recommends using potential noise impact analysis as a criterion in possible mitigation of sensitive areas when siting airports. Whereas, guidelines from the U. S. Department of Housing and Urban Development (HUD, 1983) and the Federal Interagency Committee on Urban Noise (FICUN), a predecessor to Federal Interagency Committee on Noise (FICON), (FICUN, 1980) concentrate on the second reason to protect new residents from moving into an incompatible noise environment.

The guideline from EPA recommends an average annual equivalent sound level day/night (DNL) of 55 dBA to protect the health and well being of the public with an adequate margin of safety. Guidelines and recommendations from HUD and FICUN also use DNL as their measurement metric and give tables of compatible use categories based on the existing DNL levels. For example, both HUD and FICUN use 65 DNL as their upper limit for acceptable residential development without added noise reduction construction. FICON also uses DNL as its metric.

There are no Federal, State of Alabama, or local municipal noise standards, regulations, or ordinances that apply to the action alternatives evaluated in this SEIS.

TVA uses the EPA guideline of 55 dBA DNL as a design goal when feasible if the nearest receptor is residential, and the equivalent sound level (L_{eq}) of 60 dBA at the property line in industrial and commercial areas. In addition, TVA uses the FICON (FICON, 1992) recommendation that a 3 dB increase indicates possible impact and the need for further analysis when the background DNL is 60 dBA or less. These guidelines were developed and published since the original BFN EIS. At that time, TVA used the HUD guideline of 65 dBA DNL (HUD, 1971) as normally acceptable for adjacent residential areas.

3.19.4 Potential Effects of Environmental Noise

3.19.4.1 Hearing Loss

Exposure to high noise and sound levels can cause hearing loss. The Occupational Safety and Health Administration (OSHA) regulates noise exposure in the workplace and EPA gives guidance for exposure to environmental noise to prevent hearing loss. For environmental noise, EPA recommends an average annual exposure limit of 70 dBA equivalent sound level for 24 hours [L_{eq}(24)] over 40 years to prevent hearing loss (EPA, 1974). The Occupational Safety and Health

Administration (OSHA) exposure standard is 90 dBA for eight-hour exposure over a working lifetime (OSHA, 1984).

3.19.4.2 Annoyance and Complaints

Along with the physical, hearing loss response from exposure to prolonged, high levels of environmental noise, there can be annoyance and complaints from the disturbance of social and personal activities caused by moderate levels of environmental noise exposure. Noise can interfere with communications, relaxation and sleep, and concentration. In the FICON analysis of noise effects, annoyance was identified as the summary of the general adverse reactions that people have to noise. Specifically, it states that the best measure of this adverse response is the percentage of the effected population that is characterized as "highly annoyed" as a function of DNL (FICON, 1992). FICON recommends using the updated "Schultz curve" to define the relationship between highly annoyed and DNL. The Schultz curve relationship was originally recommended by EPA in its 1982 guidance document (EPA, 1982), and it was updated by the U. S. Air Force Armstrong Laboratory (FICON, 1992). The updated relationship is:

$$\%\ \text{Highly Annoyed} = \frac{100}{1 + e^{[11.13 - 0.141(\text{DNL})]}} \qquad \textbf{Eq. 3.19-1}$$

This relationship is shown in Table 3.19-1 in tabular form below.

Table 3.19-1 Percentage Highly Annoyed Based on DNL

DNL, dBA	40	45	50	55	60	65	70	75	80	85	90
Percent Highly Annoyed	0.4	0.8	2	3	6	12	22	36	54	70	83

The discussion in the FICON document goes on to state that complaints are not an absolute measure of the impact of environmental noise on a community. It explains that annoyance can exist without complaints and the converse is also possible.

3.19.4.3 Communication Interference

Sentence intelligibility is one method of determining communication interference when background or intruding noise is broad spectrum. This is usually the case when there are multiple noise sources. In the EPA "levels" document (EPA, 1974), it estimates that there is 99% sentence intelligibility for normal voice communications when the background noise is 54 dBA or less and 100% at 45 dBA or less. This correlates very well with another presentation found in Harris (Harris, 1991) that shows that "just-reliable" normal voice communication can occur at background noise levels as high as 58 dBA when the speaker and listener are one meter apart.

Typical residential construction provides about 20 dB of noise reduction from the outside to the inside with the windows closed. This is factored into the FICUN category of "compatible" at 65 dBA DNL to give an indoor level of 45 dBA or less (FICUN, 1980) in the minimal or moderate noise exposure zones. A 20 dB noise reduction for residential construction also falls within the range of noise reduction given by EPA (EPA, 1974). The HUD guidelines state that common building construction will make the indoor noise environment acceptable when the DNL is 65 dBA or less. In higher noise exposure zones, residential structures need to be constructed with higher noise reduction to prevent potential communication interference.

3.19.5 Current Noise Environment

The current noise environment is different than prior to the construction and operation of BFN. Since that time, the residential population adjacent to BFN has grown (see section 3.19.2), the industrial park about two miles upstream and across the river has expanded, and barge traffic has increased. All of these have some effect on the noise environment. The background noise measurements presented in the original BFN EIS are not applicable to the action alternatives evaluated in this SEIS. The environmental noise evaluation of these action alternatives is concerned with the potential effects of additional cooling tower(s) and the replacement of the current cooling towers which operate during the peak of the summer. The original background noise was measured in November, 1971. A 24-hour background noise survey was conducted June 11-12, 2001, in the Paradise Shores and Lakeview communities. The survey location at Paradise Shores was about 1,500 feet from cooling tower 3 along its major axis. In Lakeview, the survey location was in a vacant lot in the center of the community. The 15 hour daytime (0700-2200) average noise was 45.7 dBA, and the nine hour nighttime average was 43.1 dBA at Paradise Shores and 44.1 dBA and 38.7 dBA at Lakeview. Predominant noise sources were typical of suburban life, and included traffic, lawn mowing, home air-conditioning units, and children. At night, insects, frogs, air-conditioning, and traffic were dominant, although Lakeview had less traffic because of a posted restriction.

A daytime noise survey of three of the current operating cooling towers was conducted July 30, 2001. Towers 2, 3, and 5 were operating, and these are the towers closest to Paradise Shores. The noise from the towers was audible at 1,500 feet in the Paradise Shores area, but it was not audible in the Lakeview Community. Measurements were taken at the same location in Paradise Shores as the background measurements, and another set of measurements was taken at 520 feet off the northwest end of tower 3 inline with the Paradise Shores measurement location. The total noise in Paradise Shores was 45.8 dBA, and at 520 feet it was 47.6 dBA. Based on the 520-foot measurements, the calculated intruding noise from the cooling towers at the 1,500-foot location in Paradise Shores is 38.4 dBA. By adding this calculated intruding noise to the daytime background noise level measured in June, the calculated total noise level is 46.4 dBA, which is similar to the total noise measurement of 45.8 dBA. The operation of towers 1 and 6 would cause a negligible increase, less than 1 dB to the total noise in Paradise Shores because the towers are an additional 1,800 feet away and partially blocked by other towers. Also, operating a cooling tower of similar design at the number 4 tower location would add about 3 dBA to the intruding noise and about 1 dBA to the total noise Leq (24 hrs.) in Paradise Shores to 47 dBA.

Noise from the three operating cooling towers was not detectable in the Lakeview Community on the day of the survey. The calculated intruding noise from the current towers would be 38 dBA based on measured data taken broadside to the towers on July 30. This intruding noise is about 6 dBA less than the daytime background noise level taken in June.

These measured and calculated noise levels, along with the number of operating days of the cooling towers, can be used to calculate the average annual DNL. In the past five years when both BFN units 2 and 3 operated, the cooling towers ran an average of 17 days per year. The range of operating days was from 7 to 27 during this time and included 12-hour start-up and 12-hour shutdown periods. The measured and calculated intruding noise at Paradise Shores, 1,500 feet from the current cooling towers, is about 42 dBA, and the 24-hour and average annual DNLs are 52 and 50 dBA, respectively. At the Lakeview Community across the river, the intruding noise from the cooling towers is not detectable, but the calculated intruding noise is 38 dBA and the 24-hour and average annual DNLs are 48 and 46 dBA, respectively. The maximum average annual DNL for the largest number of operating days, 27, is 50 dBA at Paradise Shores, and 46 dBA at Lakeview. These levels assume that all cooling towers operated the entire periods. Frequently, fewer towers operated which makes these calculated levels the maximum. Table 3.19-2 presents the current noise levels at Paradise Shores and Lakeview communities.

Table 3.19-2 Current Noise Environment*

Location	Background Leq (24 hrs.)	Total Leq (24 hrs.)	DNL 24 hrs	Average Annual DNL 17 days op.	Ave. Annual DNL 27 days op.
Paradise Shores	45	47	52	50	50
Lakeview	43	44**	48**	46**	46**

*All data are dBA.
**Noise from current operating cooling towers was not detectable; these are calculated values.

3.20 Public and Occupational Safety & Health (Non-Radiological)

3.20.1 Site Safety and Health Plan

The TVA nuclear work force has achieved recordable injury rates that are among the lowest in the utility industry. Employees are required to be trained in the safe handling of chemicals that they use in the work environment. Additionally, numerous other safety-related training courses are conducted to respond to OSHA requirements for workers. Operation and construction (i.e., refurbishment and restoration) activities are required to meet or exceed Federal regulatory requirements for safety design, inspection and OSHA regulations. BFN has a 24-hour fire and rescue staff that is Certified Emergency Medical Technicians (EMTs). Emergency medical response procedures are outlined in various Rad/Chem and Emergency Preparedness procedures. Professional medical treatment and testing is available on site with a permanent medical staff that includes a physician. The TVAN Safety and Health Manual contains requirements designed to assure that management administers a strong safety program.

Included in the Safety and Health Manual are provisions for:

Personal protective equipment use,
Safety training requirements for workers,
Accident reporting and investigative requirements,
Hazard communication and right to know,
Heat stress management,
Confined spaces,
Electrical work practices,
Use of chemicals,
Industrial hygiene,
Lead and asbestos abatement,
Fall protection, and
Job safety planning

Employees are trained in applicable safety procedures and methods prior to the start of work at the facility.

3.20.2 TVA's Employee Safety Program

There exists the potential for workers to be exposed to health and safety hazards while constructing and operating the facilities. Construction activities are conducted in accordance with OSHA Construction Industry Standards (29 CFR 1926). All other activities are conducted in accordance with OSHA General Industry Standards (29 CFR 1910) and OSHA Federal Safety and Health Program Requirements (29 CFR 1960). These standards establish practices, chemical and physical exposure limits, and equipment specifications to preserve employees' health and safety. Standards and requirements also apply to TVA contractors and vendors. Contractor operations are monitored to ensure operations are conducted in a safe and healthful manner and that they meet contract requirements.

The TVA Hazard Communication Program ensures that Material Safety Data Sheets (MSDSs) are available and appropriate labels are visible to employees for all products to which they might be exposed in the course of their workday.

TVA's Safety and Occupational Hygiene Program is designed to help the agency conduct its operations in a manner which protects the safety and health of employees. The Safety and Occupational Hygiene Program, headed by a Designated Agency Safety and Health Official (DASHO), defines the activities necessary to prevent on-the-job accidents and occupational illnesses and diseases. This program is implemented by a joint effort among TVA's managers, labor organizations, and employees with guidance and assistance from the DASHO and a professional staff. The program's highlights include:

Workplace Standards - Standards, work rules, and other practices developed by regulatory agencies and by TVA provide employees direction on safe work practices and working conditions.

Job Safety Planning - All jobs undertaken are planned by those involved in sufficient detail to ensure that hazards are identified and eliminated or controlled to an acceptable level.

Training - Each organization provides for job training to improve the safety knowledge and skills of employees and enable them to perform their jobs in a safe and healthful manner.

Employee Involvement - TVA's success in protecting people and property from accidental harm depends on the involvement of all employees in its safety program. Employees are actively involved in the development and implementation of workplace standards and other program activities to minimize unsafe acts and conditions through participation on safety and health committees and through interaction with management and fellow employees.

Workplace Inspection Monitoring and Audits - Workplaces are regularly inspected and monitored to ensure that they meet regulatory and agency requirements. Regular audits assess the effectiveness of inspection and monitoring programs as well as activities to prevent accidents and illnesses. These audits provide the feedback necessary to ensure control of workplace hazards and keep efforts focused on continuous improvement.

Accident Reporting and Investigation - All accidents are reported and investigated by management. Investigations address the following elements:

- Root causes are identified,
- Corrective action to prevent future accidents is recommended,
- Accident data is analyzed for trends to help direct future safety program efforts, and
- Information is shared throughout TVA to support the accident prevention efforts to other organizations.

3.20.3 Fire Protection

BFN has a Fire Protection Plan which is applicable to all activities at or related to BFN which could affect the life or health of TVA employees or the public, the probability or severity of potential fires throughout the plant, or the ability to maintain safe plant shutdown, or limit radioactive release to the environment in case of fire. To assure that the program functions properly and to meet the requirements of 10 CFR 50.48, a Fire Protection Plan has been developed for BFN. The Fire Protection Plan is incorporated into the UFSAR by reference as recommended in NRC Generic Letter 86-10. This document is the sole source for fire protection program commitments at BFN. The Fire Protection Plan contains the current fire protection commitments that affect the Fire Protection Program. The Fire Protection Plan is revised, as required, to reflect all new commitments that affect the BFN Fire Protection Program.

The objectives of the Fire Protection Plan are achieved through the integration of fire protection into the design, construction, operation, and maintenance of the plant and equipment; by fire prevention techniques; and by providing appropriate fire detection and suppression features and fire rated compartmentation. This is known as a defense-in-depth concept, which employs multiple levels of safety measures to attain the required high degree of safety. In addition, the defense-in-depth approach includes the proper administrative controls necessary to maintain program integrity.

The BFN fire protection systems are designed to provide automatic fire protection for known hazardous areas where it is practical to do so, to provide adequate warning of fire in hazardous areas where automatic protection is not feasible, to provide adequate manually-actuated fire protection systems for the entire plant and yard areas (i.e., hose stations, hydrants, etc.), and to ensure the maintenance of divisional integrity of safety-related systems to the extent that the capability for safe shutdown of the reactors is assured during and after a fire. The common parts of the BFN fire protection systems are the high pressure water subsystem (supplies sprinkler/spray systems and fire hose stations), the low pressure carbon dioxide subsystems (used in plant areas with flammable oil and electrical hazards), the fire detection/annunciation and protective action initiation systems, and the compartmentation and fire retardant systems.

Fire prevention is an important part of the overall BFN Fire Protection Plan. The primary objective of the fire protection activities is to prevent fire from occurring. The plant fire prevention program consists of identification, evaluation, and control of fire hazards. Administrative controls have been established to control both combustibles and ignition sources to the greatest extent possible. Procedures have been established to minimize fire hazards and fire protection impairments in areas containing structures, systems, and components important to safety and to maintain the performance of the fire protection systems and personnel. NFPA guidelines have been used as a basis for these procedures.

Effective handling of fire emergencies is an important aspect of the BFN defense-in-depth Fire Protection Program. This is accomplished by the provision of a trained and qualified emergency response organization, the fire safety awareness of all plant employees, a comprehensive pre-fire plan, safe shutdown procedures, and the ability of the operations personnel to perform such procedures.

3.20.4 Electric and Magnetic Fields

TVA recognizes there is public concern about whether any adverse health effects are caused by electric and magnetic fields (EMF) that result from generation, transmission, distribution, and use of electricity. Many scientific research efforts and other studies examining the potential health and other effects of EMF have been and are being done. TVA is aware of, and ensures that it stays aware of, published research and study results, and directly supports some of the research and study efforts.

Studies, interpretations, and research to date are not conclusive about potential associations between electric or magnetic fields and possible health impacts. A few studies have been interpreted by some as suggesting a weak statistical relationship between magnetic or electric fields and some form of rare cancer. However, equal numbers of similar studies show no association. The present weight of this type of evidence does not allow any conclusion and does not indicate a cause and effect relationship between fields and health effects. No laboratory research has found such a cause and effect adverse health impact from EMF, and no concept of how these fields could cause health effects has achieved scientific consensus.

TVA's standard for siting new transmission lines has the effect of minimizing public exposures to EMF during their operation.

3.20.5 Shock Hazards

Shock hazards are produced mainly through direct contact with conductors and have effects ranging from a mild tingling sensation to death (NRC, 1991). The transmission line towers associated with the BFN Plant are designed to preclude direct public access to the conductors. However, secondary shock currents are produced when persons contact capacitively charged objects (such as vehicles parked near a transmission line) or magnetically linked metallic structures (such as fences near a transmission line). Shock intensity depends on the strength of the electric field, the size and location of the object, and the ground insulation. Design criteria that limit hazards from steady state currents are based on the National Electrical Safety Code (NESC), which requires that transmission lines are designed to limit the short-circuit current to ground produced from the largest anticipated vehicle to less than 5 milliamperes (NRC, 1991). TVA's design ensures that the transmission lines meet the requirement given in NESC (TVA, 1994b). Therefore, the impact of shock hazards and EMF exposure are minimal, as a result of operation of the BFN Plant.

3.20.6 Airborne Pathogenic Microorganisms

Some thermophilic microorganisms associated with cooling towers and thermal discharges can have deleterious impacts on human health. These microorganisms include the enteric pathogens *Salmonella* sp. and *Shigella* sp., as well as *Pseudomonas aeruginosa* and thermophilic fungi. Methods of testing for these microorganisms are known and their presence in aquatic environments is often controllable. Other microorganisms normally present in surface water, but not as easily detected or controlled, include the bacteria *Legionella* sp. (which causes Legionnaires' disease) and the amoebae of the genera *Naegleria* and *Acanthamoeba*, which causes a rare but very serious human infection, primary aerobic meningoencephalitis (PAME) (NRC, 1991).

Legionella sp. has been found in the aerosols in the vicinity of condensers or cooling tower basins that were in the process of being cleaned. Two reported cases of infections related to *Naegleria* sp. that were associated with the cleaning of cooling towers have been reported (NRC, 1991). For this reason, utilities that identify microorganisms that are responsible for PAME in the cooling tower often require respiratory protection for workers in the vicinity of the cooling towers and condensers.

The potential health effects from *Naegleria* sp. at sites such as the BFN site, located on rivers with average flow rates less than 2,830 cubic meters per second (100,000 cubic feet per second), are a public health concern (NRC, 1991). These microorganisms occur in surface water where the risk of infection is always present. Increases in average water temperature due to weather or climatic conditions, or from the discharge of heat, may cause an increase in the levels of the microorganisms. Information obtained by TVA in discussions with the Centers for Disease Control and Prevention indicated that to contract primary amoebic meningoencephalitis from *Naegleria* sp., large doses of cyst-contaminated water must enter the nasal mucosa area. A few cases have been reported in swimmers from Texas and the Carolinas during the past few years; however, these were not associated with aerosol cysts from power plant cooling towers (TVA, 1994g). The Tennessee Department of Health was not aware of any cases for which either *Legionella* sp. or *Naegleria* sp. was associated with cooling towers in Tennessee (TVA, 1994b). TVA concludes that the operation of the BFN plant has not resulted, and is not likely to result, in adverse effects to human health as a result of the presence of these microorganisms.

3.20.7 Hazardous Chemicals

Table 3.20-1 lists the hazardous chemicals in storage for use at BFN, along with their storage location. All of the hazardous chemicals at BFN are either stored inside plant buildings, or are equipped with secondary containment to contain the chemicals in the event of a spill. None of the chemicals stored on-site exceeds the quantity limitations that would require preparation of a Risk Management Plan under 40 CFR Part 68.

In accordance with State and Federal Regulations, BFN has developed a Spill Prevention, Control and Countermeasure (SPCC) Plan that includes spill response assignments and responsibilities, best management practices for controlling and managing oil and chemical storage, and contingency plans in the event of an incident.

BFN has an on-site Hazardous Materials Response Team that is trained and certified to respond to, contain, and clean up oil and hazardous chemicals that may be released. In addition, BFN has the necessary supplies and equipment on-site to control chemical releases, and has arrangements in place for outside assistance in the event of a serious incident.

BFN maintains Material Safety Data Sheets for all hazardous chemicals on-site, and operates a Chemical Traffic Control (CTC) Program to control the use and distribution of chemicals on the site.

Implementation of the alternatives discussed in this EIS would not result in significant differences in the amounts or types of hazardous chemicals stored or used at BFN on an annual basis. All chemicals proposed for use on-site are reviewed and approved for use through the CTC program.

Table 3.20-1 Chemical Storage by Area

Drainage[a] Area	Location	Substance	Physical State	Maximum Storage[b]	Storage Vessels	Secondary Confinement Type	Secondary Confinement Percent of Maximum Storage Capacity
4	Hazardous Waste Storage Building	waste solvents, waste acid, and waste caustic, spent fluorescent lighting	liquid	825	drums (15)	Floor drain sump	91
1	Intake	sodium hypochlorite	liquid	5,700	tank (1)	Concrete wall and floor	>100
		Calgon H-940 (sodium bromide)	liquid	5,700	tank (1)	Concrete wall and floor	>100
		Calgon CL-50 (sodium hexametaphosphate)	liquid	1,600	tank (1)	Double-walled tank	100
		Calgon PCL-401 (anionic copolymer)	liquid	1,600	tank (1)	Double-walled tank	100
		Calgon H-300 (glutaraldehyde)	liquid	300	bin (1)	Plastic pan	>100
		Calgon EVAC (molluscicide)	liquid	300	bin (1)	Plastic pan	>100
1	Offgas Building	ethylene glycol	liquid	15,000	tanks (3)	Building sump	>100
1	Modifications Area • Oil Rack	methyl ethyl ketone	liquid	165	drums (3)	Metal pans	>100
		mineral spirits	liquid	385	drums (7)	Metal pans	>100
		ethylene glycol	liquid	110	drums (2)	Metal pans	>100
	• Paint Shop	paints, epoxies, and resins	liquid	1,500-2,000	1- and 5-gallon cans	None	-
1	• Materials Procurement Complex (MPC-B3B (BFN-1) (MPCJ)	hydrazine (35%)	liquid	165	drums (3)	None	-
		paint thinners	liquid	770	drums (14)	None	-
		boric acid	granular	3,425 lbs.	bags (35)	Not applicable	-
1	Reactor Building	aqueous film-forming foam	liquid	900	tank (3)	Floor drain sump	>100
		sodium nitrite (30%)	liquid	5	tank (1)	Floor drain sump	>100
		sodium pentaborate (9.2%)	liquid	4,850	tank (2)	Floor drain sump	>100

Table 3.20-1 Chemical Storage by Area

Drainage[a] Area	Location	Substance	Physical State	Maximum Storage[b]	Storage Vessels	Secondary Confinement: Type	Secondary Confinement: Percent of Maximum Storage Capacity
4	Mixed Waste Storage Area	waste solvents, waste acids, and waste caustic, waste lead paint chips	liquid solid	3,465	drums (63)	Floor drain sump	65
1	• Service Building • • Paint Room • Power Stores	paint ethylene glycol mineral spirits thinner sodium nitrite	liquid liquid liquid liquid solid	100 165 660 330 360 lbs.	cans (40) drums (3) drums (12) drums (6) plastic bags or jars	None None None None Not applicable	- -
	Thinner Rack (near Service Building)	thinners	liquid	330	drums (6)	None	_
1	Turbine Building	sodium hypochlorite Calgon PCL 401 (anionic copolymer) Calgon CL 50 Calgon EVAC Calgon H-300 Calgon H-940 hydrazine (0.1%) hydrazine (35%) ammonium hydroxide (50 ppm)	liquid liquid liquid liquid liquid liquid liquid liquid liquid	8,530 1550 4400 300 300 1550 125 55 125	tank (1) tank (1) tank (1) bin (1) bin (1) tank (1) reservoirs (1) drum (1) tank (1)	Containment diking dike dike plastic pan plastic pan dike Floor drain collector tank Metal pan Floor drain collector tank	>100 >100 >100 >100 >100 >100 >100 >100 >100 >100

[a]There are no chemicals of concern stored in drainage areas 2 and 3.
[b]Units are gallons unless otherwise stated.

3.20.8 Site Emergency Response Plan

BFN has a Radiological Emergency Plan (REP) which addresses organizational responsibilities, capabilities, actions and guidelines for TVA during a radiological emergency. However, the REP is also designed to be implemented based on a variety of situations that could potentially adversely affect the operations of a TVA nuclear plant such as BFN. In addition to radiological emergencies, these include natural events, chemical spills, toxic gas releases, fires, plant operational problems, etc., which may pose a threat to the safe operation of the plant and have a potential impact offsite. The REP is described in Section 3.21.3.

3.21 Radiological Impacts Baseline

3.21.1 Normal Operations

3.21.1.1 Occupational

Occupational radiological impacts refer to radiation dose received by individuals in the course of their employment. Section 4.3.21.1.1 contrasts the current industry and facility occupational radiation dose trends against the current limits established by federal regulation to minimize the potential health risk to individual workers. At BFN, the average annual dose to workers and the average collective worker dose per reactor are consistent with current industry trends for this type of reactor (boiling water reactor) and worker radiation exposures are controlled to be significantly less than regulatory limits.

3.21.1.2 Public

Commercial nuclear power reactors, under controlled conditions, release small amounts of radioactive materials to the environment during normal operation. These releases result in radiation doses to humans that are small relative to doses from natural radioactivity. Nuclear power plant licensees must comply with NRC regulations (e.g., 10 CFR Part 20, Appendix I to 10 CFR Part 50, 10 CFR Part 50.36a, and 40 CFR Part 190) and conditions specified in the operating license.

The BFN Off-site Dose Calculation Manual (ODCM) provides the methodology used to calculate offsite doses based on gaseous and liquid effluent releases from the plant. These releases are reported in BFN's annual radioactive effluent release report. The ODCM specifies the parameters used to calculate potential off-site doses due to radioactive liquid and gaseous effluents and to ensure compliance with the following limits:

- The concentration of radioactive liquid effluents released from the site to the unrestricted area will be limited to levels that meet regulatory requirements.
- The exposure to any individual member of the public from radioactive liquid effluents will not result in doses greater than the design objectives of 10 CFR Part 50, Appendix I.
- The exposure to any individual member of the public from radioactive gaseous effluents will not result in doses greater than the design objectives of 10 CFR Part 50, Appendix I.

- The dose to any individual member of the public from the nuclear fuel cycle will not exceed the limits in 40 CFR Part 190 and 10 CFR Part 20.
- The dose rate from radioactive gaseous effluents at any time at the site boundary will be limited to:
  (a) less than or equal to 5 mSv/yr (500 millirem per year (mrem/yr) to the whole body and less than or equal to 30 mSv/yr (3,000 mrem/yr) to the skin for noble gases, and
  (b) less than or equal to 15 mSv/yr (1,500 mrem/yr) to any organ for iodine-131 and -133, tritium, and for all radioactive materials in particulate form with half-lives greater than eight days.

BFN's recent operating experience has shown that doses from gas and liquid effluents are a small fraction of the applicable radiological dose limits.

TVA has conducted a Radiological Environmental Monitoring Program (REMP) since 1973 to assess the impact of BFN operations on the surrounding environs and the general public. The purpose of the REMP is to:

- Provide verification that radioactive material released to the environment as a result of plant operations and the ambient environmental radiation levels attributable to plant operations are within the NRC regulatory limits and the EPA environmental radiation standards in 40 CFR Part 190.
- Provide for the assessment of any measurable buildup of long-lived radionuclides in the environment.
- Monitor and evaluate ambient environmental radiation levels.
- Determine if plant operations results in any statistically significant increase in the concentration of radionuclides in the environs of the plant site.

The REMP conducted for BFN is designed to monitor the primary pathways for exposure to humans. The BFN REMP includes measurement of direct radiation levels and collection and analysis of various sample types. Monitoring for the liquid pathway includes samples of fish, shoreline sediment and water from the Tennessee River. The airborne pathway is monitored by direct sampling for air particulates and gaseous radioiodine and sampling of milk, soil, and food crops that could be affected by the deposition of airborne radionuclides.

The results from the REMP are reported in the Annual Radiological Environmental Operating Report (AREOR). The data reported in the BFN AREOR demonstrate that the small amounts of radiological effluents released to the environment due to the operation of BFN have had no measurable impact on the environs around BFN.

Estimated doses to the maximum exposed member of the public due to radiological effluent releases from BFN are calculated on an annual basis. These dose values have consistently been very low, typically only a small fraction of applicable limits. For example, the maximum calculated whole body dose for liquid releases in 1999 was 0.037 mrem/year, or 1.2% of the applicable limit (10 CFR 50 App. I, 3mrem/year). The maximum organ dose equivalent from gaseous effluents in 1999 was 0.04 mrem/year which represented 0.3% of the limit (10 CFR 50 App. I, 15 mrem/year). The calculated whole body or other organ (other than thyroid) dose was 0.12 mrem (0.5% of the 40 CFR 190 limit, 25 mrad/year) for 1999. The calculated thyroid dose was 0.082 mrem (0.1% of the 40 CFR 190 limit, 75 mrad/year) for 1999.

There are also no significant changes to the radiological effluent releases anticipated as a result of BFN operations over the current license period.

3.21.2 Facility (Design Basis) Accidents

The BFN Updated Final Safety Analysis Report (UFSAR) Chapter 14 addresses several design basis accidents such as Loss of Coolant Accident (LOCA), Main Steam Line Break (MSLB), Control Rod Drop Accident (CRDA), and Fuel Handling Accident (FHA). Since the design basis accidents are independent of the age of the plant, the extension of the lifetime operation of the plant from 40 years to 60 years will not impact the analysis of these accidents. This conclusion applies to all BFN units.

The originally licensed maximum thermal power level for the BFN units was 3293 megawatt thermal (MWt). The current analyses in Chapter 14 address BFN operation at the present 5% uprated power level of 3458 MWt. EPU at 120% of the originally licensed maximum thermal power level will affect accident analysis because the power level influences the radioactive isotope inventories and releases. The analyses will be re-performed at EPU power levels, and the plant will conform to regulatory requirements prior to implementation of EPU.

Extension of the plant life from 40 years to 60 years will impact equipment qualification (EQ) of safety related equipment. The total integrated radiation doses will generally increase by 50%. However, the BFN 10 CFR 50.49 (EQ) program will ensure that all safety related equipment will be qualified to operate in its intended environment so as to perform its intended function. Any equipment that cannot withstand the full 60-year life of the plant will be replaced on a predetermined maintenance schedule as part of the 10 CFR 50.49 program. At any time during the life of the plant, the equipment will be qualified for its environment, and will be on a regular maintenance/replacement schedule as needed. Therefore, life extension will not negatively impact the safety of the public following an accident.

3.21.3 Site Radiological Emergency Response Plan

The following discussions detail how the BFN REP fulfills Federal (10 CFR 50) and State and Local (44 CFR 350) requirements.

10 CFR PART 50 DOMESTIC LICENSING OF PRODUCTION AND UTILIZATION FACILITIES

The REP has been developed to provide protective measures for TVA personnel, and to protect the health and safety of the public in the event of a radiological emergency resulting from an accident at a TVA nuclear plant. This plan, which has been approved by the NRC, fulfills the requirements set forth in Part 50, Title 10 of the Code of Federal Regulations, and was developed in accordance with the NRC and Federal Emergency Management Agency (FEMA) guidance. As specified in NUREG-0654, Criteria for Preparation and Evaluation of Radiological Emergency Response Plans in Support of Nuclear Power Plants and REG Guide 1.101, the REP provides for the following:

- Adequate measures are taken to protect employees and the public.
- Individuals having responsibilities during an accident are properly trained.
- Procedures exist to provide the capability to cope with a spectrum of accidents ranging from those of little consequence to major core melt.
- Equipment is available to detect, assess, and mitigate the consequences of such occurrences.

- Emergency action levels and procedures are established to assist in making decisions.

The REP, together with the appendices, describes the methods TVA will use to:

- Detect an emergency condition.
- Evaluate the severity of the problems and conduct environmental monitoring.
- Notify Federal, State, and local agencies of the condition.
- Activate the TVA emergency organizations.
- Evaluate the possible off-site consequences by performing dose assessments.
- Recommend protective actions for the protection of the public.
- Mitigate the consequences of the accident.
- Maintain a drill and exercise program.

Since TVA authority is limited to TVA-owned and -controlled property, State and local agencies are responsible for ordering and implementing actions offsite to protect the health and safety of the public.

Specific procedures are developed to ensure that the plan is implemented as designed. These implementing procedures are designed to ensure that accidents are properly evaluated, rapid notifications made, and assessment and protective actions performed. These procedures are compiled in the EPIPs. Site specific procedures for abnormal and emergency operation and control exist but are not included in the EPIPs. These plant-operating procedures are designed to ensure the implementation of the EPIPs.

44 CFR PART 350 REVIEW AND APPROVAL OF STATE AND LOCAL RADIOLOGICAL EMERGENCY PLANS AND PREPAREDNESS

State Radiological Emergency Plans (SREPs) have been developed to provide a guide for the response of the State Government to any emergency caused by an incident at a TVA operated Nuclear Plant. The plan also provides integrated response actions of Federal, State, and local governments to an emergency that causes, or has the potential for causing, a release of a significant amount of radioactive material into the environment. In accordance with this plan, the State, in coordination with each concerned agency, will provide timely warning and protection for those citizens who may be threatened by an accident or incident at the plant. This plan fulfills the requirements set forth in Part 350, Title 44 of the Code of Federal Regulations, and was developed in accordance with the NRC and FEMA guidance.

As specified in NUREG-0654, Criteria for Preparation and Evaluation of Radiological Emergency Response Plans in Support of Nuclear Power Plants, the SREPs address State and local concepts of operation, organization, administration and logistics, communications, execution, authority and reference, and supporting plans. In addition, plans include annexes to provide guidelines for more specific planning and response information used to protect the public during a radiological emergency. The SREPs has been evaluated and approved by the FEMA which has the responsibility to ensure the adequacy for off-site planning.

The plan, to include annexes, describes the methods the involved agencies use relating to:

- Direction and Control,
- Alert , Warning, and Notification,
- Communications,
- Public Information and Education,
- Radiological Protection Measures for public and emergency workers, to include utilization of radiological and environmental monitoring for the assessment and minimization radiological health hazards,
- Medical and Public Health,
- Plume Exposure Emergency Planning Zone/Ingestion Pathway Zone, to include protective actions decision making for controlling the distribution and use of food and water and consumption of radio-protective drugs, and advising the agriculture community concerning livestock and farm products,
- Evacuation,
- Security,
- Reentry, Recovery, and Return,
- Radiological Emergency Response Training, and
- Exercises.

Since State and local agencies are responsible for ordering and implementing off-site actions for the protection of the health and safety of the public, county implementation procedures are also included.

3.21.4 Severe Accident Mitigation Alternatives

For purposes of this SEIS, the term "accident" refers to any unintentional event (i.e., outside normal or expected plant operations) that result in the release or potential release of radioactive material to the environment. Generally, the nuclear industry and the NRC categorize accidents as "design basis" or "severe." Design basis accidents are those for which the risk is great enough that a nuclear plant is required to be designed and constructed to prevent unacceptable accident consequences. Severe accidents are those considered too unlikely to warrant design controls.

The NRC has concluded in its generic license renewal rulemaking that unmitigated environmental impacts from severe accidents met the criteria for exclusion from requiring additional plant-specific analyses. Nonetheless, the NRC, noting that 1) ongoing regulatory programs related to severe accident mitigation have not been completed for all plants, and 2) these programs have identified plant programmatic and procedural improvements (and in a few cases, minor modifications) as cost-effective in reducing severe accident risks and consequences, elected to require that alternatives to mitigate severe accidents be considered for all plants that have not considered such alternatives. Site-specific information to be presented includes: 1) potential SAMAs; 2) benefits, costs, and net value of implementing potential SAMAs; and 3) sensitivity of analysis to changes to key underlying assumptions.

BFN has previously completed a Probabilistic Safety Assessment (PSA), which is a systematic and comprehensive analysis of the potential accidents that can occur at the plant. The PSA is a thorough description of the frequency and consequences of potential accidents; it incorporates both system reliability and human involvement in plant safety. The BFN PSA evaluates the potential for core damage during power operation (i.e., "Level I" analysis) and also includes containment failure and radionuclide source term estimations following core damage (i.e., "Level II" analysis). It does not, however, evaluate the effects of radionuclide release to the surrounding environment (i.e., "Level III" analysis); this is an integral part of a SAMA analysis.

In response to NRC requirements, BFN has also previously completed an Individual Plant Examination (IPE) which addresses internal events, and an IPE for External Events (IPEEE) such as flood, earthquake, fires, etc. The IPE and IPEEE are less comprehensive than the current PSA, but they utilize standardized methodology which allows some degree of comparison of results between plants. Like the PSA, they involve Level I and II analyses which have been used to identify plant programmatic and procedural improvements (and in some cases, minor modifications) which are effective in reducing severe accident and risk consequences.

A SAMA analysis has been prepared for BFN that addresses operation during the 20-year license renewal period and relates the costs of potential programmatic, procedural, and physical changes to benefits associated with reducing the radiological damage to the surrounding environment (Level III). This analysis is included as Appendix A of this SEIS.

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